

Nov. 19, 1946.

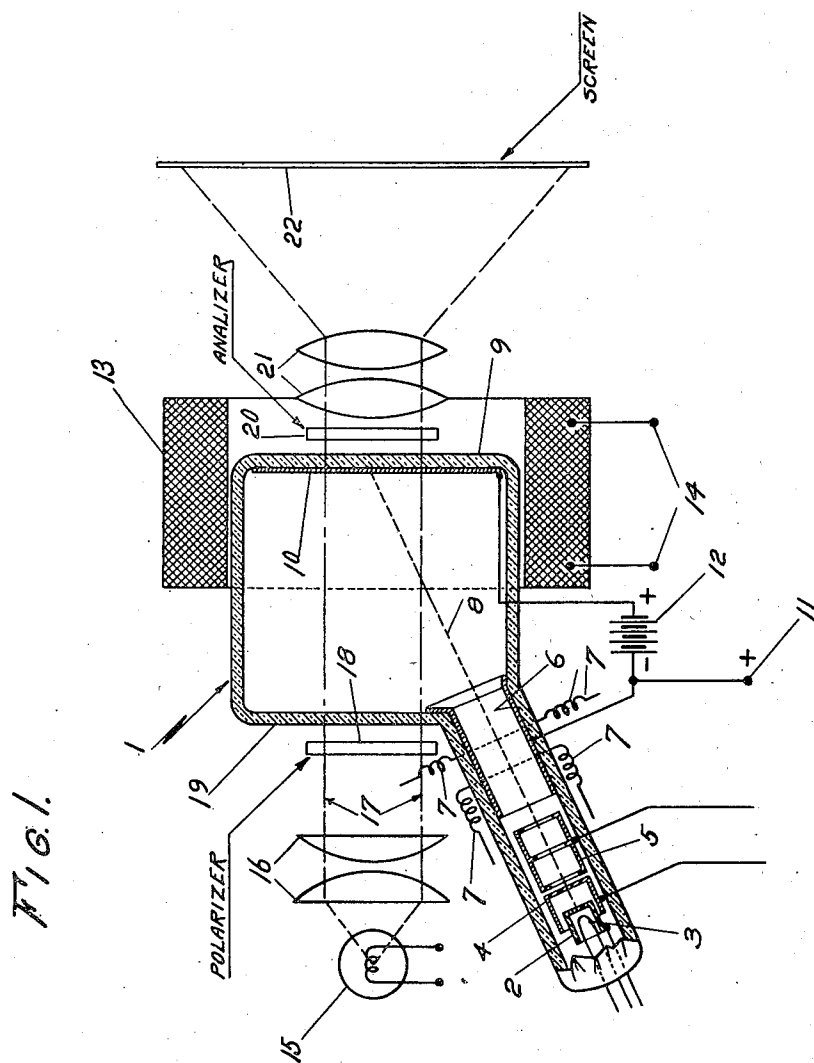
E. J. GORN

2,411,155

TELEVISION RECEIVING SYSTEM

Filed Sept. 14, 1944

4 Sheets-Sheet 1



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Nov. 19, 1946.

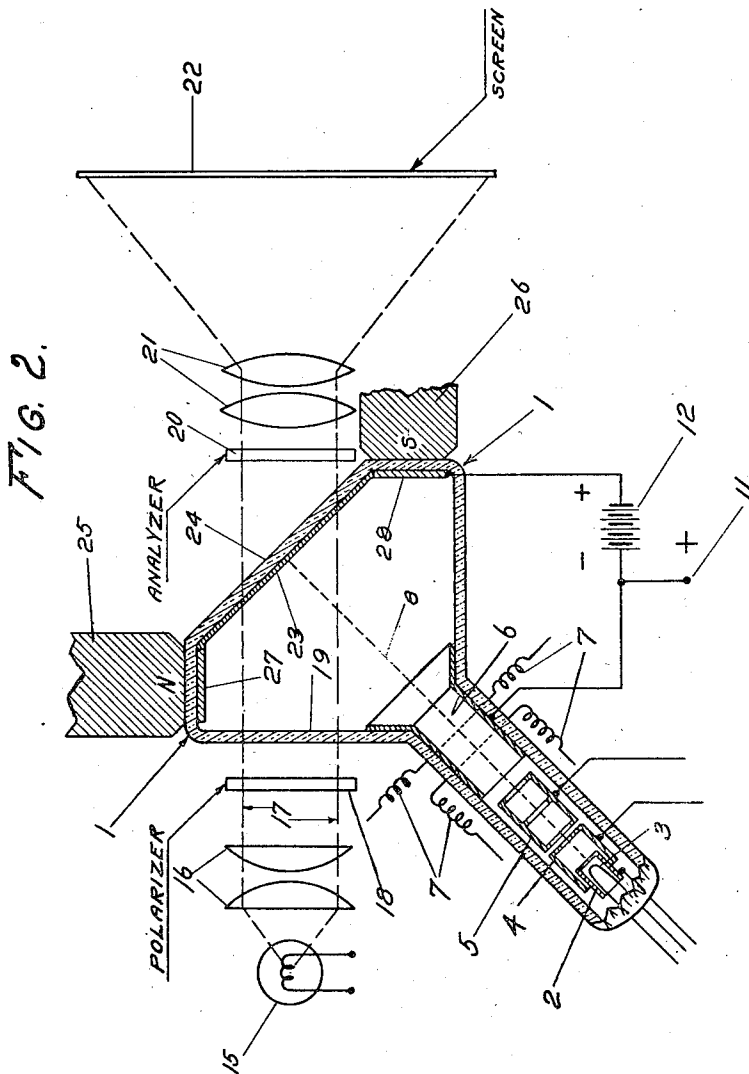
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4 Sheets-Sheet 2



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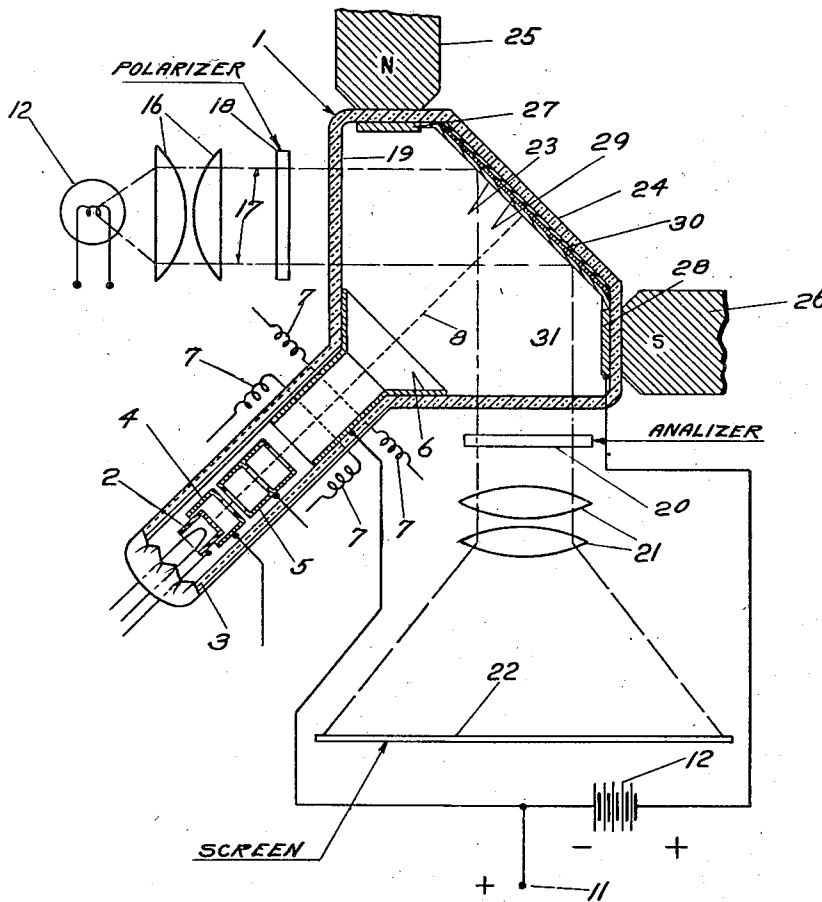
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FIG. 3.



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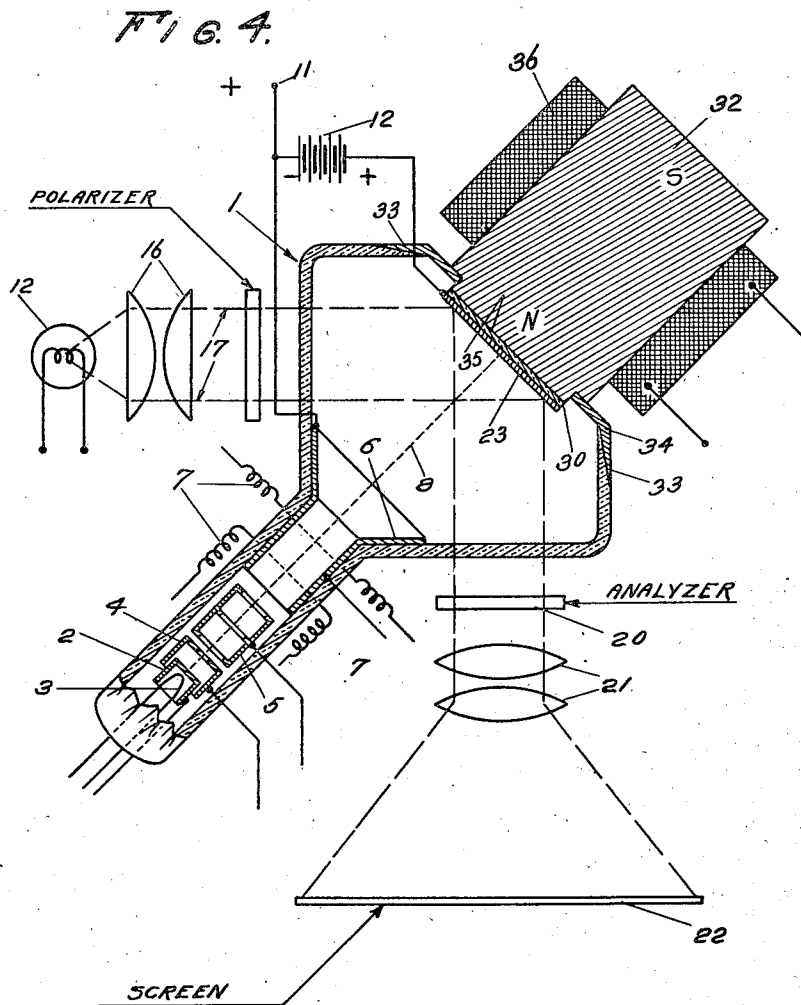
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TELEVISION RECEIVING SYSTEM

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UNITED STATES PATENT OFFICE

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TELEVISION RECEIVING SYSTEM

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9 Claims. (Cl. 88—61)

1

This invention relates to a television receiving system.

In a television receiving system it is desirable to utilize a receiver screen which will act to modulate a light beam passing through it, the modulation varying from point to point on the screen in accordance with the intensity values of the received picture signals so that the light thus modulated may either be viewed directly or enlarged and projected onto a viewing screen to give a reproduction of the picture.

An object of this invention is to produce a novel screen of the foregoing type utilizing the property of a film of magnetic material to rotate the plane of polarization of polarized light passing through such a film in a strong magnetic field, and in which the magnetic properties of the film are varied from point to point in order to recreate a received picture.

Another object is to produce the above variation in the magnetic properties of the film by bombarding the film with a beam of electrons.

The foregoing and other objects of this invention will be best understood from the following description of exemplifications thereof, reference being had to the accompanying drawings wherein in Figs. 1, 2, 3 and 4 represent different forms of apparatus embodying my invention.

In the form shown in Fig. 1, a cathode ray tube is provided within an evacuated envelope 1 containing, at one end thereof, a cathode 2 adapted to be heated to temperature of thermionic emission by a heating filament 3. The electrons emitted from the cathode 2 are controlled by means of a control electrode 4, accelerated by a first anode 5 and focused by the electrostatic field formed between the first anode 5 and the second anode 6. The electron beam thus produced is deflected by deflecting coils 7 or by any other well known deflecting means so as to produce a scanning beam of electrons 8. The electron beam 8 is directed toward an end wall 9 of the envelope 1, said end wall being made of suitable clear glass. The end wall 9 is coated on its interior surface with a thin film 10 of magnetic material such as iron. This film is sufficiently thin so as to be substantially transparent to light. A suitable positive potential may be applied to the second anode 6 from a terminal 11. The film 10 may be electrically connected to the second anode 6. In some cases it may be desirable to insert an additional source of voltage 12 in the connection between the film 10 and the second anode 6 so as to make the film somewhat more positive than said second anode.

2

In order to create a strong magnetic field through the film 10, the envelope 1 is surrounded adjacent said film by a coil 13 energized from terminals 14 with a sufficient current so as to create as strong a magnetic field as possible with the lines of flux extending substantially perpendicularly through the film 10. The coil 13 may be provided with a suitable external core structure, not shown, so as to maximize the magnetic field through the film 10.

A strong source of light 15, which may be for example an incandescent lamp, is provided to produce the beam of light to be modulated. The light coming from the source 15 is concentrated by an optical condenser 16 which thus forms a beam of light 17. The beam 17 is passed through a polarizer 18 which allows polarized light vibrating substantially in one direction only to pass through it. Therefore, the light, which comes through the polarizer 18, is polarized in a predetermined plane, this polarized light then passing through an end wall 19 of the envelope 1, said end wall formed of suitable clear glass. After the beam of polarized light enters the envelope 1, it is passed through the film 10 and the opposite end wall 9.

As indicated above, if polarized light passes along the direction of the lines of flux through a thin film of magnetic material in a strong magnetic field, the plane of polarization of the light will be rotated through a substantial angle. Thus when the polarized lightbeam 17 passes through the film 10, its angle of polarization is rotated. As the beam of light emerges from the end wall 9, it is caused to fall upon an analyzer 20 which permits light polarized substantially in one direction only to pass through it. With no electron beam 8 falling upon the film 10, the analyzer 20 may be oriented with its plane of polarization at right angles to the plane of polarization of the light coming through the end wall 9. Under these conditions the analyzer 20 will not pass any of the light and therefore the beam will be completely extinguished. As an alternative arrangement, the analyzer 20 may be oriented so that its plane of polarization is parallel with the plane of polarization of the light coming through the end wall 9. Under these conditions the light is free to pass through the analyzer 20.

The beam of light which passes through the analyzer 20 is projected by the projection lens 21 and is cast as an enlarged image on the projection screen 22.

When the screen 10 is bombarded with a beam of electrons of sufficient intensity, the material

3

of the screen 10 is excited to such a degree as to destroy the magnetic properties of the material and render said material non-magnetic. When this occurs the plane of polarization of the light passing through the film 10 is no longer rotated and therefore the plane of polarization of the light falling upon the analyzer 20 is changed. In case the analyzer has been set for extinction, this change allows light to pass through whereas, if the analyzer has been oriented initially so as to allow light to pass through it, extinction of the light will occur. As the intensity of the electron beam is reduced or as the beam moves away from an excited spot on the screen 10, that spot quickly loses its excitation and regains its magnetic properties. The plane of polarization of the light passing through the wall 9 is thereupon restored to its original position and the initial conditions of passage of light through the analyzer 20 are restored.

The picture signals which are received and impressed upon the control electrode 4 are caused to modulate the strength of the electron beam 8 above and below the critical value at which the magnetization of the material in the film 10 is destroyed. Thus as the electron beam 8 scans the film 10, the elemental light and dark areas of the desired picture will be recreated in the film 10 as non-magnetic and magnetic elemental areas. In the case where the analyzer 20 is initially set for extinction, the non-magnetic elemental areas will correspond to the light areas of the picture. Conversely, in the case where the analyzer 20 is initially set for passage of light, the non-magnetic elemental areas will correspond to the dark areas of the picture. When the magnetic properties of the film 10 have been modulated as described above, the light which comes through the analyzer 20 will represent accurately the received picture values and therefore this picture can be projected by the lens 21 onto the viewing screen 22.

In some cases difficulty may be encountered in securing a sufficiently high intensity of magnetic field through the film 10 in the arrangement as shown in Fig. 1 so as to produce a maximum effect. Fig. 2 shows an alternative arrangement in which a high intensity of magnetic field throughout the film 10 is more readily obtainable. In Fig. 2 the same reference numerals are applied where the elements are identical with those in Fig. 1. In Fig. 2 the thin magnetic film 23 is placed upon an end wall 24 of the envelope 1, said end wall being located at an angle to the beam of polarized light 17 passing through it. The magnetic field is passed through the film 23 in a direction parallel to the plane thereof by means of external magnetic poles 25 and 26. These external magnetic poles may be part of a strong permanent magnet or a strong electro-magnet. In order more readily to lead the flux into the film 23, a pair of internal, thickened magnetic poles 27 and 28 may be mounted within the envelope 1 adjacent the upper and lower edges respectively of the film 23. These magnetic poles likewise tend to shield the electron beam 8 against distorting effects of the external magnetic field. By this arrangement very high intensities of magnetic field may be created in the film 23. By passing the polarized light beam 17 through the film 23 at an angle thereto, there will be a substantial component of light parallel to the direction of the lines of flux so as to produce the desired rotation of the plane of polarization of the light as it passes through the film

4

23. In this arrangement likewise modulation of the magnetic properties of the film 23 is secured by bombarding said film with the modulated electron beam 8.

An increase in the angle of rotation of the plane of polarization may be secured by the arrangement shown in Fig. 3. In this figure the same reference numerals are applied where the elements are identical with those of Fig. 2. In Fig. 3 instead of permitting the polarized light beam to pass through the end wall 24, said end wall is provided with a reflecting layer 29 which may be, for example, a mirror film of silver. Between the reflecting layer 29 and the thin magnetic film 23 there is preferably placed a thin layer 30 of a highly dielectric transparent material such as a glass having a high dielectric constant. Thus the light beam 17 passes through the film 23 and the layer 30 whereupon it is reflected from the layer 29 back through the layers 30 and 23. The reflected light emerges from a lower wall 31 of the envelope 1, said lower wall being made of suitable clear glass. The analyzer 20, the lens 21 and the screen 22 are placed in the path of the beam 17 as it emerges from the lower wall 31.

The action of the system shown in Fig. 3 is substantially identical with that of Fig. 2 except that an increased effect may be secured by an increase in the rotation of the plane of polarization which is produced when the magnetic properties of the film 23 are present.

In the embodiment illustrated in Fig. 4 the same reference numerals are applied where the elements are identical with those of Fig. 3. In Fig. 4 there is provided a magnet 32 sealed in the wall of the envelope 1. This magnet may be carried by a sealing ring 34 whose edges 33 are sealed to the glass of the envelope 1. The magnet 32 may be provided with a strong magnetic field by means of a suitable energizing coil 36. Of course it is to be understood that the magnet 32 could be a permanent magnet if so desired. The magnet 32 is provided with a polished pole surface 35 which carries the dielectric layer 30 and the thin magnetic film 23 as described in Fig. 3. In Fig. 4 the polarized light beam 17 is passed through the film 23 and the layer 30 and then is reflected from the polished pole face 35 in a manner similar to that described in connection with Fig. 3. The rotation of the plane of polarization by the film 23 and the variation thereof have already been described above.

The polished pole surface 35 in Fig. 4 has the property of rotating the plane of polarization of polarized light reflected from it. If, however, the plane of polarization of the incident light is so oriented that the electric vector thereof is either parallel or perpendicular to the plane of the pole face 35, such a rotation will not occur. Therefore, the polarizer 18 is so oriented that when the magnetic properties of the film 23 are destroyed, the plane of polarization of the incident light on the pole face 35 has its electric vector either substantially parallel or substantially perpendicular to the pole face 35. Such a relationship will be termed "non-rotative" in the specification and claims herein. However, the parallel relationship of the electric vector is preferred to the perpendicular relationship. With the above non-rotative orientation of the electric vector, when the magnetic properties of the film 23 are restored, the film will rotate the plane of polarization of the incident light beam 17 and in this way the electric vector will likewise be

5

rotated out of its non-rotative relationship with respect to the pole face 35. Thereupon the reflection of the light beam 17 from the pole face 35 will introduce an additional rotation of the plane of polarization which will be added to the rotation produced by the film 23. With such an arrangement, therefore, the difference between the angular positions of the plane of polarization when the film 23 is magnetic and when it is non-magnetic is increased. This produces an increased differential between the light and dark portions of the reproduced picture.

In the arrangement of Fig. 4 it is to be understood that the magnet 32 may be configured in any convenient way so that the pole external to the envelope 1 may be located to intensify the magnetic field passing through the film 23 and likewise to configure the magnetic field with the envelope 1 so as to produce a minimum of disturbances in the scanning of the film 23 by the electron beam 8.

Of course it is to be understood that this invention is not limited to the particular details as described above inasmuch as many equivalents will suggest themselves to those skilled in the art. For example the representation of the means of producing the electron beam 8 and the scanning thereof is intended to be purely diagrammatic and in many instances it will be found desirable to substitute other types of scanning arrangements. It is accordingly desired that the appended claims be given a broad interpretation commensurate with the scope of the invention within the art.

What is claimed is:

1. In combination: a transparent film of magnetic material; means for passing a beam of polarized light through said film; means for creating a magnetic field through said film to rotate the initial plane of polarization of said light; and means for altering the magnetic properties of said film, whereby the angle through which said plane of polarization is rotated may be varied.

2. In combination: a transparent film of magnetic material; means for passing a beam of polarized light through said film; means for creating a magnetic field through said film to rotate the initial plane of polarization of said light; and means for altering the magnetic properties of said film by bombarding the same with an electron beam whereby the angle through which said plane of polarization is rotated may be varied.

3. In combination: a transparent film of magnetic material; means for passing a beam of polarized light through said film; means for creating a magnetic field through said film to rotate the initial plane of polarization of said light; and means for altering the magnetic properties of said film by scanning the same with an intensity-modulated electron beam, whereby the angle through which said plane of polarization is rotated may be varied.

4. In combination: a transparent film of magnetic material; means for passing a beam of polarized light through said film; means for reflecting said light whereby it passes through said film a second time; means for creating a magnetic field through said film to rotate the initial plane

6

of polarization of said light; and means for altering the magnetic properties of said film, whereby the angle through which said plane of polarization is rotated may be varied.

5. In combination: a transparent film of magnetic material; means for passing a beam of polarized light through said film; means for reflecting said light whereby it passes through said film a second time; means for creating a magnetic field through said film to rotate the initial plane of polarization of said light; and means for altering the magnetic properties of said film by bombarding the same with an electron beam, whereby the angle through which said plane of polarization is rotated may be varied.

6. In combination: a transparent film of magnetic material; means for passing a beam of polarized light through said film; means for reflecting said light whereby it passes through said film a second time; means for creating a magnetic field through said film to rotate the initial plane of polarization of said light; and means for altering the magnetic properties of said film by scanning the same with an intensity-modulated electron beam, whereby the angle through which said plane of polarization is rotated may be varied.

7. In combination: a transparent film of magnetic material; means for passing a beam of polarized light through said film; means for creating a magnetic field through said film to rotate the initial plane of polarization of said light; said last-named means being provided with a highly polished surface disposed at the rear of said film whereby the plane of polarization of said light is further rotated, and said light is passed through said film a second time; and means for altering the magnetic properties of said film, whereby the angle through which said plane of polarization is rotated may be varied.

8. In combination: a transparent film of magnetic material; means for passing a beam of polarized light through said film; means for creating a magnetic field through said film to rotate the initial plane of polarization of said light; said last-named means being provided with a highly polished surface disposed at the rear of said film whereby the plane of polarization of said light is further rotated, and said light is passed through said film a second time; and means for altering the magnetic properties of said film by bombarding the same with an electron beam, whereby the angle through which said plane of polarization is rotated may be varied.

9. In combination: a transparent film of magnetic material; means for passing a beam of polarized light through said film; means for creating a magnetic field through said film to rotate the initial plane of polarization of said light; said last-named means being provided with a highly polished surface disposed at the rear of said film whereby the plane of polarization of said light is further rotated, and said light is passed through said film a second time; and means for altering the magnetic properties of said film by scanning the same with an intensity-modulated electron beam, whereby the angle through which said plane of polarization is rotated may be varied.

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