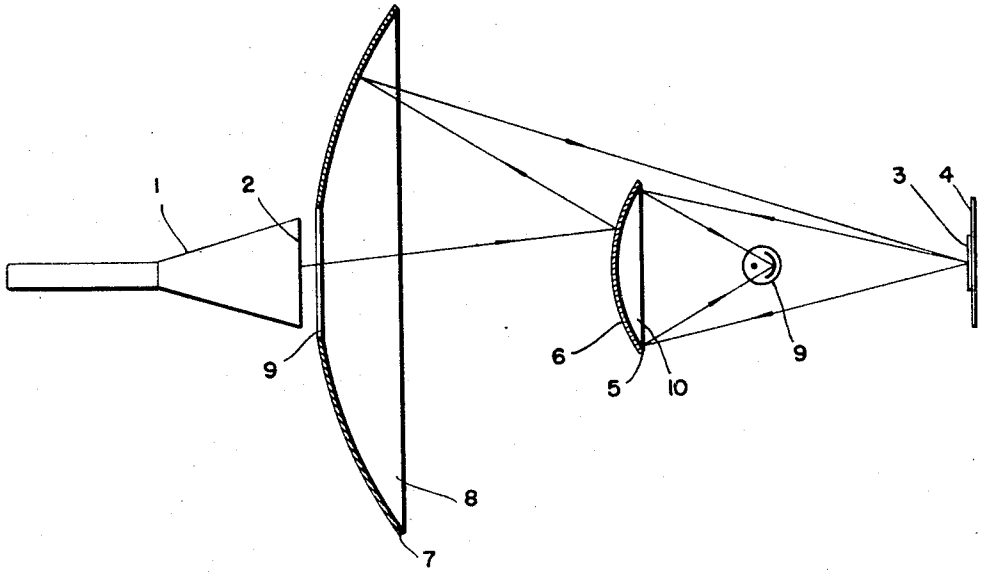
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CATOPTRIC PROJECTION SYSTEM FOR FLYING SPOT SCANNING

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CATOPTRIC PROJECTION SYSTEM FOR FLYING SPOT SCANNING

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8 Claims. (Cl. 178—7.7)

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This invention relates to scanning systems and has particular reference to the so-called "flying spot" scanning systems.

There are encountered in television operations a number of situations where, either for reasons of economy or because of space or other physical limitations, it is impractical to employ one of the conventional image analyzing devices such as the image dissector, the iconoscope, the orthicon and image orthicon. In such situations it is becoming more and more the practice to revert to the principles of the older flying spot scanning systems. Added impetus to the use of such a scanning system has recently been given by the development of a cathode ray tube for use as the flying spot of light.

A cathode ray is deflected according to the desired scanning pattern over a fluorescent screen to generate the light spot. However, in order to be effective at the present standard scanning frequencies, the fluorescent screen must have a relatively short persistence. The phosphors used in tubes of this character to form the fluorescent screens have spectral emission characteristics such that a large portion of the radiation is in the near ultra-violet region. It is this ultra-violet radiation which has the required short persistence characteristic.

In order to scan the television subject with a flying spot of light produced by means of a cathode ray tube of the character described, it is necessary to employ some form of optical system. In addition, it is necessary to provide another optical system for collecting the light from the television subject. This light may be reflected from the subject in the case of live pickup or may be transmitted through the subject where the subject is a film or other transparency. So far as is known, the optical systems which have been employed for such purposes have been of the conventional refractive types, that is, they consist of lenses made of glass, plastics or the like. Such optical systems are known to be relatively inefficient in their use of the light. In the first place, in order to accomplish the desired focusing of the light, a refractive optical system must of necessity have a relatively small effective aperture. Secondly, it is necessary to provide a correction for the ultra-violet radiation. Furthermore, refractive systems absorb a relatively large proportion of the ultra-violet radiation.

It, therefore, is an object of the present invention to provide a catoptric or all reflecting optical system for use in conjunction with flying spot television scanning apparatus.

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Another object of the invention is to provide a concentric catoptric system for projecting a flying spot of light onto a television subject and for gathering the light modulated in accordance with the subject.

Still another object of the invention is to provide a concentric catoptric system in combination with a flying spot scanning device for projecting the spot of light onto the television subject and having at least a part thereof for gathering the light from the subject and focusing it onto a phototube.

In accordance with the present invention, there is provided a flying spot television scanning system including, for example, a cathode ray tube for generating a flying spot of light and also including a catoptric system comprising a plurality of curved reflecting surfaces located so as to project the flying spot onto a television subject.

In accordance with one feature of the invention the reflecting surfaces of the catoptric system are spherical and are all substantially concentric. According to another feature of the invention, a back surface of one of the reflecting members is employed to gather light from the television subject and to direct it onto a phototube.

For a better understanding of the invention together with other and further objects thereof, reference is made to the following description, taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

The single figure of the accompanying drawing is a diagrammatic representation of an illustrative embodiment of the invention.

Referring now to the drawing, there is shown a cathode ray tube 1 having its short persistence fluorescent screen 2 directed toward the television subject 3. This illustration of a television subject is intended to typify substantially all of the subjects customarily televised. It may be a live subject or an opaque card or the like bearing indicia, in either of which cases the light to be employed in generating the video signals will be reflected from the subject. Alternatively, the television subject may be a transparency such as a photographic film which is capable of modulating the light by transmission through the subject. In such a case it is preferable to provide a reflecting member such as a mirror 4 in back of the transparent subject.

A catoptric system, such as that disclosed in greater detail in a copending application of F. C. P. Henroteau, Serial No. 608,450, filed Aug-

ust 2, 1945 and entitled "Concentric optical system" is interposed between the fluorescent screen 2 of the cathode ray tube and the television subject 3. This system consists of a plurality of substantially spherical reflecting members. In its simplest form the catoptric system consists of a spherical member 5 which, for the purpose of projecting light from the cathode ray tube screen 2 onto the television subject 3, has its convex surface 6 provided with light reflecting material. The catoptric system also includes another spherical member 7 located between the cathode ray tube screen 2 and the convex reflecting surface 6 of the spherical member 5. The spherical member 7 has its concave surface 8 provided with reflecting material and also includes a central aperture 9 in substantial registry and alignment with the screen of the cathode ray tube. In accordance with the preferred form of the invention the reflecting surfaces 6 and 8 of the catoptric system not only are spherical but also are concentric. These two surfaces are employed for projecting the light from the cathode ray tube screen 2 onto the television subject 3 in accurate focus.

In order to utilize the light modulated either by reflection from or transmission through the television subject, there is provided a phototube 9 which, in the preferred form of the invention, is located between the television subject and the spherical member 5 of the catoptric system. The concave spherical surface 10 of the member 5 which faces the phototube 9 is provided with light reflecting material. The fluorescent screen 2 of the cathode ray tube, the members 5 and 7 of the catoptric system, the television subject 3 and the phototube 9 all are in axial alignment.

Inasmuch as the operation of the apparatus described is considered to be evident from the foregoing description, only a brief outline of the operation is believed to be necessary. The cathode ray tube 1 will be understood to include the usual means for developing and projecting an electron beam onto the fluorescent screen 2. Also there will be employed as auxiliaries of the tube the usual focusing and deflecting systems whereby the cathode ray may be scanned over the surface of the fluorescent screen according to the conventional pattern in television systems. It is to be understood that the fluorescent screen 2 of the cathode ray tube is of the type previously referred to having a relatively short persistence so that, as the cathode ray impinges successive elemental areas of the screen, there will be produced on the viewing surface of the screen a flying spot of light. All of the rays of light emanating from any given spot on the fluorescent screen falling within the solid angle subtended by the solid arc of the spherical member 5 will be reflected by the convex reflector 6. The drawing shows one such light ray which travels from the screen 2 in the direction of the arrow to the convex reflector 6 by which it is reflected toward the spherical member 7. Upon striking the concave reflector 8, the typical light ray again is reflected in the direction of the arrow toward and onto the television subject 3. In the case where the television subject is a transparency the light will travel through the subject striking the reflecting surface of the member 4 by which it is reflected for passage again through the television subject. In the case where the television subject 3 is an opaque object the reflector 4 may be dispensed with since the light striking the subject will be directly reflected thereby. The

light from the television subject is directed onto the concave reflecting surface 10 of the spherical member 5 by which it is again reflected and directed onto the photosensitive cathode of the phototube 9. Since the light reaching the phototube from the television subject is modulated in accordance with the subject, there will be produced a response by the phototube which is representative of the scansion of a succession of elemental areas of the subject. The output of the phototube may be coupled to any conventional amplifying and carrier wave modulating system for the development of the desired video signals from which the television subject may be reproduced in a well known manner.

Inasmuch as the energy in the flying spot of light developed by the fluorescent screen 2 of the cathode ray tube includes a relatively high degree of ultra-violet radiation, it is seen that the employment of a catoptric or all reflecting optical system for projecting this light onto the television subject and also for collecting the subject-modulated light for impression upon the phototube 9 obviates the necessity for providing the compensation for the ultra-violet radiation which is necessary when optical systems employing one or more refractive devices are used. Furthermore, the character of the catoptric system consisting of concentric spherical reflecting members provides a relatively wide angle system thereby effecting a greater efficiency of operation. Moreover, the dual use of one of the spherical members of the catoptric system for projecting light onto the subject and for collecting light therefrom enables considerable simplification in the apparatus employed.

Inasmuch as this system, as well as most optical systems, is reversible it is considered to be obviously within the scope of the invention that the source of the flying spot of light and the phototube may be interchanged in relation to the catoptric system.

While there has been described what is at present considered the preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and it is, therefore, aimed in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. In a television scanning system, a subject to be scanned, an optical system comprising a first optical member having a convex reflecting surface and an oppositely disposed concave reflecting surface facing said subject, a second optical member having a centrally disposed aperture and a concave reflecting surface facing the convex reflecting surface of said first optical member, a source of a flying spot of light facing one of the reflecting surfaces of said first optical member, and a phototube facing the other reflecting surface of said first optical member.

2. In a television scanning system, a subject to be scanned, an optical system comprising a first optical member having a convex spherical reflecting surface and an oppositely disposed concave spherical reflecting surface facing said subject, a second optical member having a centrally disposed aperture and a concave spherical reflecting surface facing the convex reflecting surface of said first optical member, a source of a flying spot of light facing one of the reflecting surfaces of said first optical member, and a

phototube facing the other reflecting surface of said first optical member.

3. In a television scanning system, a source of a flying spot of light, a television subject to be scanned by said flying light spot, a first optical member having a convex reflecting surface facing said light source and a concave reflecting surface facing said television subject, a second optical member having a concave reflecting surface facing the convex reflecting surface of said first optical member and also having a centrally disposed aperture in alignment with said light source, and a phototube facing the concave reflecting surface of said first optical member.

4. In a television scanning system, a source of a flying spot of light, a television subject to be scanned by said flying light spot and facing said light source, a first optical member having a convex reflecting surface facing said light source and a concave reflecting surface facing said television subject, a second optical member having a concave reflecting surface facing the convex reflecting surface of said first optical member and also having a centrally disposed aperture in alignment with said light source, and a phototube located between said first optical member and said television subject, and facing the concave reflecting surface of said first optical member.

5. In a television scanning system, a source of a small spot of light moving in accordance with a predetermined scanning pattern, a television subject to be scanned by said moving light spot and facing said light source, a first optical member located between said light source and said television subject and having a convex reflecting surface facing said light source and a concave reflecting surface facing said television subject, a second optical member located between said light source and said first optical member and having a concave reflecting surface facing the convex reflecting surface of said first optical member and also having a centrally disposed aperture in alignment with said light source, and a phototube located between said first optical member and said television subject and facing the concave reflecting surface of said first optical member.

6. In a television scanning system, a source of a small spot of light moving in accordance with a predetermined scanning pattern, a television subject to be scanned by said moving light spot and facing said light source, a first optical member located between said light source and said television subject and having a convex spherical reflecting surface facing said light source and a concave spherical reflecting surface facing said television subject, a second optical member located between said light source and said first optical member and having a concave spherical reflecting surface facing the convex reflecting surface of said first optical member and also having a centrally disposed aperture in alignment with said light source, and a phototube located between said first optical member and said television subject and facing the concave reflecting surface of said first optical member.

7. In a television scanning system, a cathode ray tube having a fluorescent screen and adapted to the production of a small spot of light moving over said screen in accordance with a predetermined scanning pattern, a television subject to be scanned by said moving light spot and facing said fluorescent screen, a first optical member located between said cathode ray tube screen and said television subject and having a convex spherical reflecting surface facing said fluorescent screen and a concave spherical reflecting surface facing said television subject, a second optical member located between said fluorescent screen and said first optical member and having a concave spherical reflecting surface facing the convex reflecting surface of said first optical member and also having a centrally disposed aperture in alignment with the fluorescent screen of said cathode ray tube, said optical members having the same center of curvature, and a phototube located between said first optical member and said television subject and facing the concave reflecting surface of said first optical member.

8. In a television scanning system, a cathode ray tube having a fluorescent screen and adapted to the production of a small spot of light moving over said screen in accordance with a predetermined scanning pattern, a television subject to be scanned by said moving light spot and facing said fluorescent screen, a relatively small optical member located between said cathode ray tube screen and said television subject and having a convex spherical reflecting surface facing said fluorescent screen and a concave spherical reflecting surface facing said television subject, a relatively large optical member located between said fluorescent screen and said relatively small optical member and having a concave spherical reflecting surface facing the convex reflecting surface of said relatively small optical member and also having a centrally disposed aperture in alignment with the fluorescent screen of said cathode ray tube, said optical members having the same center of curvature, and a phototube located between said relatively small optical member and said television subject and facing the concave reflecting surface of said relatively small optical member.

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No references cited.