July 18, 1939. I. L. MAGUIRE 2,166,313

TELEVISION SYSTEM

Filed Feb. 15, 1936 3 Sheets-Sheet 1

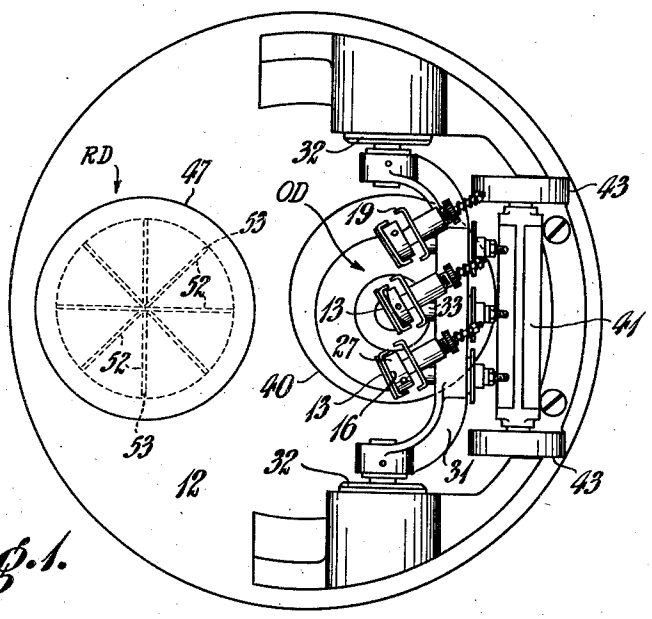



Fig. 1.

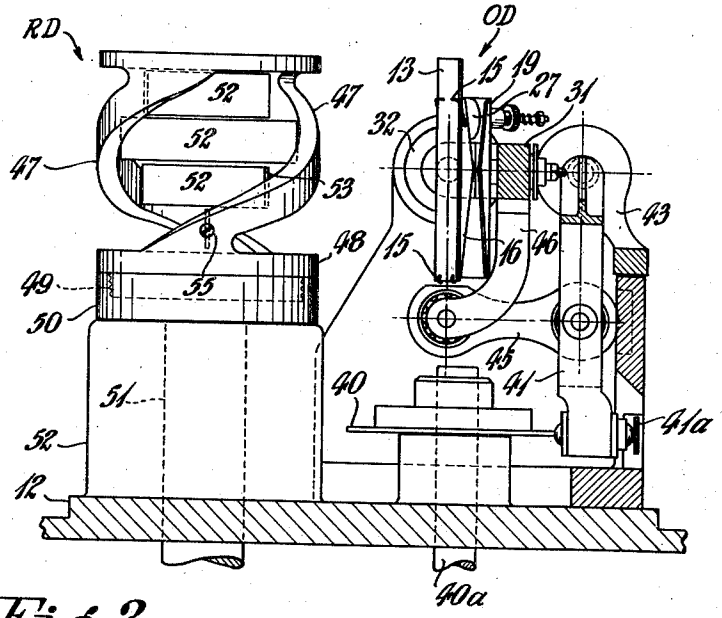



Fig. 2.

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TELEVISION SYSTEM

Filed Feb. 15, 1936 3 Sheets-Sheet 2

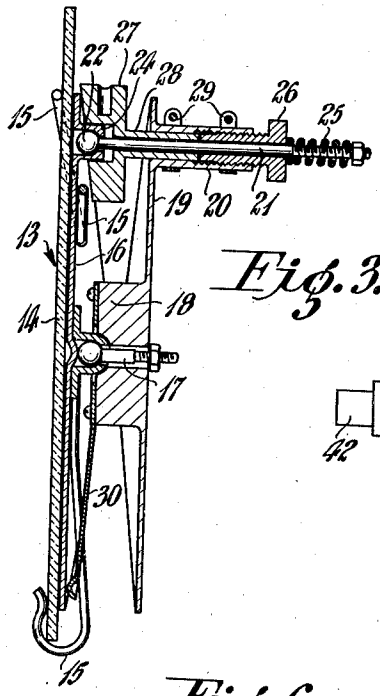



Fig. 3.

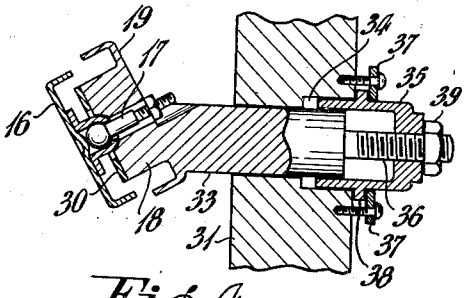



Fig. 4.

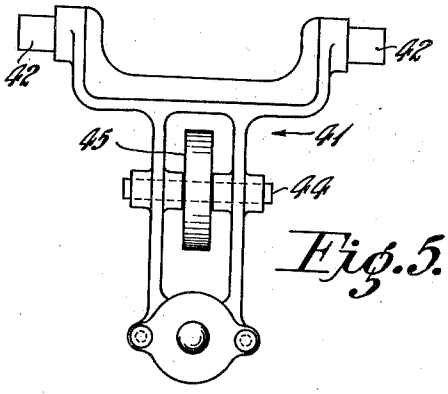



Fig. 5.

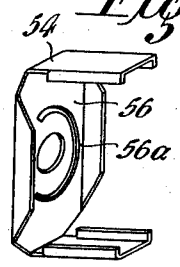



Fig. 6.

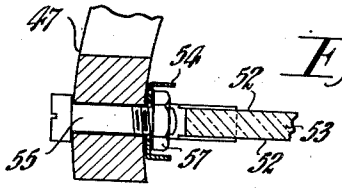



Fig. 7.

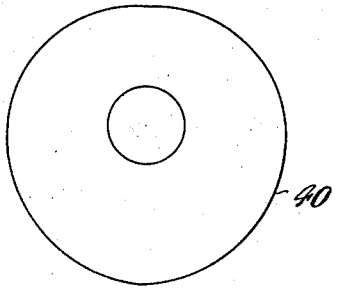



Fig. 9.

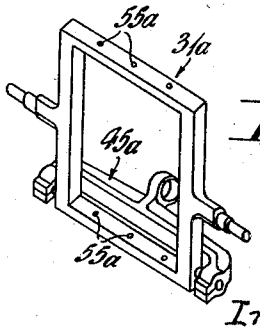



Fig. 8.

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TELEVISION SYSTEM

Filed Feb. 15, 1936 3 Sheets-Sheet 3

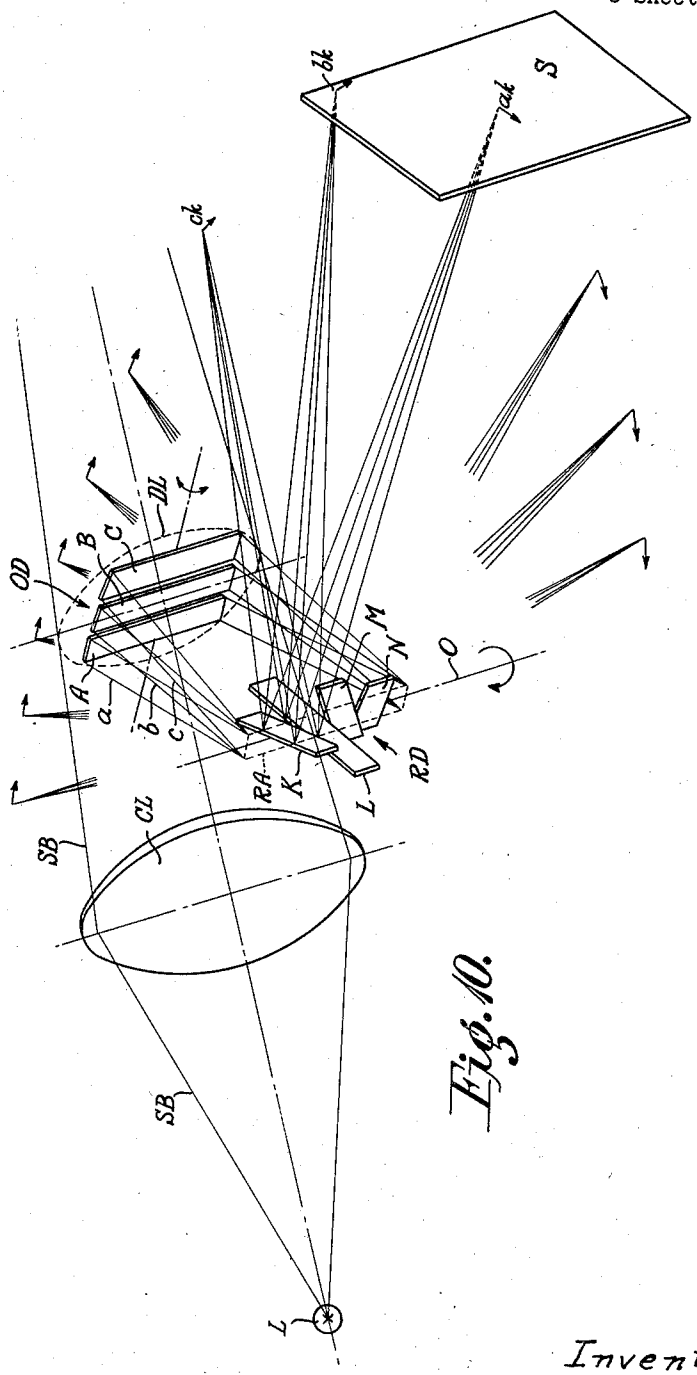



Fig. 10.

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Patented July 18, 1939

2,166,313

# UNITED STATES PATENT OFFICE

2,166,313

## TELEVISION SYSTEM

Irwin Leonard Maguire, Elwood, Victoria, Australia

Application February 15, 1936, Serial No. 64,153
In Australia February 20, 1935

11 Claims. (Cl. 178—7.6)

It is well known in the art of television that numerous difficulties are experienced in Nipkow disc and mirror drum and mirror screw and oscillating mirror types of transmitting and receiving apparatus when large images are to be finely scanned.

Various major disadvantages in above types of apparatus may be summarised as follows:

The necessarily large diameter of a Nipkow disc sets up mechanical troubles due to the rate of speed at which the disc is required to rotate and the substantial numerical magnitude of the small scanning apertures utilized for scanning creates difficulty in the projection of light through the latter and inability to utilize any appreciably substantial amount of the available light.

In mirror drums the reproduction of the same movements to the beam of light at the transmitter and receiver is a matter of difficulty because the point of incidence of the beam on the mirror does not coincide with the axis of rotation of the mirrors and therefore it is difficult to arrange corresponding mirrors of the transmitter and receiver at the required radii to produce exactly similar movements of the incident beams of light.

This difficulty results from the beam of light having imparted to it an angular movement and a linear displacement due to the varying radii from the axis of rotation of the point of incidence of the beam of light on the mirror.

Further difficulties arise in setting the angle of each mirror relative to the axis of the drum so that each mirror will scan a particular line on the image; in obtaining a uniformly brilliant picture throughout the length of a scanning line owing to the reflected light from the mirror having a maximum amount of light flux when it is reflected from the centre of the mirror, a minimum amount of light flux being reflected when the beam is incident at the edges of the mirror; in causing a beam to be swept across a screen without change in the orientation of the image relative to the screen; in imparting a relatively large angular movement to the incident beams of light; in directing a large beam of light upon the mirrors while concurrently converging to a spot of light on the screen, without diminution of the amount of flux of the beam which is incident upon the screen; and in utilizing the same mirror of the drum, with a single scanning aperture, to describe a multiplicity of similarly parallel or concentric scanning lines per picture frame.

Further difficulty occurs in the use of mirror drums and discs and mirror screws, particularly where more than one beam is simultaneously utilized for scanning, because the lengths of paths of the beams of light reflected from the mirrors to the focal plane of the viewing screen varies, which results in loss of focus and the tracing of dissimilarly shaped lines and the lines of the picture are neither parallel or concentric.

In oscillating mirrors utilized for scanning picture lines and frames, difficulty is experienced in faithfully reproducing at the receiver the same movements of the mirrors at the transmitter, and also because the oscillatory movements of the mirrors vary according to a harmonic law which results in the rate of time at which the picture elements are scanned, being less at the start and finish of a line or picture frame than during the scanning of the centre of the line and picture frame, as the case may be, with consequent greater brilliance of the illumination of the picture at the edges than in the centre.

In the use of mirror drums and mirror screws further difficulty is experienced because of the distortion and the unintentional movements of the beams of light incident thereon which are produced by centrifugal forces. These effects are produced by the means of anchoring and because of the arrangement of the deflectors.

According to this invention the disadvantages above specified are appreciably reduced by dividing the light flux from a single source of light into two or more beams, and continuously imparting to these latter beams approximately uniform but dissimilar angular velocities in two directions so angularly related that the ends of such beams incident on a viewing screen trace in cyclical order, a series of substantially parallel lines. The several beams mentioned may be set up, and the imparting of dissimilar angular velocities thereto can be effected, by directing the light from a source to the axis of rotation of an oscillating deflector unit moving with approximately uniform angular velocity and comprised of two or more deflectors, which latter direct the beams proceeding therefrom with a constant angular relationship to one another, coincidently to an axis about which are rotating with uniform angular velocity two or more deflecting surfaces (hereinafter termed the rotating deflector unit) radially disposed about and arranged along a common axis of rotation to which said surfaces the latter beams of light are continuously directed, the light proceeding thence to the viewing screen.

In a practical application of the invention when applied to a receiver a modulated light flux

is directed to a suitably sized aperture or reflecting surface thence the light is directed through a suitable focussing lens as a converging beam of light to the above defined oscillating deflector unit, and from the latter to the beforementioned rotating deflector unit and from the latter to a light sensitive cell or viewing screen.

The accompanying drawings depict a practical construction of the beforementioned oscillating deflector unit and rotating deflector unit.

In these drawings:

Fig. 1 is a plan view of the assembly upon a common base plate 12 of a rotating deflector unit at RD and an oscillating deflector unit at OD both these units being constructed and arranged in accordance with features of this invention.

Fig. 2 is a sectional elevation of Fig. 1.

Fig. 3 is an enlarged detail view in longitudinal section of a deflector in the oscillating deflector unit, Fig. 4 being a similar view in transverse section of a deflector.

Fig. 5 is an enlarged detail view in rear elevation of a portion of the mechanism for imparting oscillatory motion to the oscillating deflector unit at OD in Fig. 1.

Fig. 6 is an enlarged perspective view of an adjustable end socket for one of the rotary deflectors in the rotating deflector unit at RD in Fig. 1, or in oscillating deflector unit Fig. 8, Fig. 7 being a transverse section illustrating the mounting of same.

Fig. 8 depicts an alternative arrangement of the crank movement of the oscillating deflecting unit shown in Fig. 7.

Fig. 9 is a plan view of a cam constituting portion of the mechanism for imparting oscillatory motion to the oscillating deflector unit at OD in Fig. 1.

Fig. 10 is a diagrammatic view of an arrangement of oscillating and rotating deflecting surfaces for performing the invention.

Referring particularly to the enlarged detail views in Figs. 3 and 4 of an oscillatng deflector, the deflecting surface 13 formed on a plane strip 14 of any suitable material is detachably secured by spring clips 15 on the plane face of a carrier member 16 having a ball and socket and pin attachment at 17 to a central boss 18 in a plate 19.

At the upper end and on the rear face of the plate 19 is provided a hollow cylindrical projection 20 through which passes a rod 21 having a terminal spherical head 22. The rod 21 is held under tension in a seating formed in a socket 24 formed on the rear face of the carrier member 16 (see Fig. 3), by the spring 25 wrapped about the rod and bearing at one end against the end of an adjustable guide bearing 26 while the other end bears against a terminal nut screwed on said rod 21 so that the tension of spring 25 can be adjusted.

To control the longitudinal adjustment of the carrier member 16 about its axis at 17 an adjustable cam plate 27 is provided about the socket 24 and engages the rear face of the upper end of said carrier member 16. The cam plate 27 is adjustable by rotation of its hollow stem 28 about the rod 21 and within the cylindrical projection 20, the latter acting as an outside bearing for said stem and the screwed guide bearing 26 as a stop against rearward movement of the cam plate 27.

To lock against movement the parts carried by the cylindrical projection 20 the latter may be provided with a longitudinally disposed split and clamping bands at 29.

The leaf spring 30 attached to the boss 18 bears against the rear surface of the lower end of the carrier member 16 and maintains the latter in contact with the cam plate 27.

Each of the oscillating deflector units at OD is carried by a crank member 31 (see Fig. 1) having end bearings at 32, and for this purpose the plate 19 is formed on an offset stem 33 (see Fig. 4) fitting a stepped recess 34 in said crank member 31 and longitudinal adjustment of the stem 33 in said recess is effected by means of a sleeve 35 screw threaded on the screw 36 and held in position by a stop ring 37, secured by screws to the crank member 31, and engaging an exterior collar 38 on the sleeve 35, the latter and the stem 33 being locked against movement by the terminal lock nut 39 on the screw 36.

Oscillation of the crank member 31 carrying the oscillating deflector units at OD is primarily derived from a continuously rotating cam 40 mounted on a spindle 40a coupled to a positive rotary driving means (not shown) (see Fig. 2).

Preferably said cam 40 is contoured to ensure that uniform linear velocity will be imparted to the incident ends of the beams of light deflected from the deflecting surfaces at OD and in opposite directions on a viewing screen and parallel to the axis of rotation of the rotating deflector unit RD.

The cam 40 is in brushing contact with one end of a T-shaped pendulous arm 41 (see Fig. 5) having aligned pivots 42 in bearing standards 43.

The end of the pendulous arm 41 is maintained in working contact with its actuating cam 40 by a leaf spring 41a as indicated in Fig. 2.

The depending limb of the pendulous arm 41 carries a transverse spindle 44 passing through one end of a bar link 45 pivoted thereon, the opposite end of the latter link 45 being pivoted to the free end of a depending arm 46 from the crank member 31.

The rotating deflector unit at RD comprises a window apertured metal casing 47 (see Fig. 2) with its base 48 screwed as indicated in dotted lines at 49 to a terminal head 50 on a spindle 51 passing through a bearing block 52 and the base plate 12 for coupling to rotary driving means (not shown). The casing 47 may be constituted of a glass cylinder.

The rotary deflecting surfaces 52 are provided on both sides of the plane faced strips 53, the latter being secured at the ends to the casing 47 by the means shown in detail in Figs. 6 and 7 and consisting of a flanged U-shaped clip 54 and through bolt 55.

In lieu of providing a deflecting surface on both sides of a plane faced strip, a film of light deflecting material may be mounted between a pair of parallel glass strips.

Each end of each of the strips 53 is held between the parallel limbs of the clip 54 and the bridging member 56 of the latter is apertured for the free passage of the bolt 55. To obviate transmission of distorting stresses to the ends of the strips 53 when the nut 57 on the bolt 55 bears tightly on the bridging member 56 the material of the latter is interrupted as by a C-shaped slot 56a as shown in Fig. 6.

In the modification illustrated in Fig. 8 of the crank mounting for the oscillating reflecting units, the ends of the latter are mounted in a clip 54 previously described with reference to Figs. 6 and 7 and the securing bolts 55 for said

clips pass through apertures **55***a* in the closed trunnioned carrier frame **31***a* (see Fig. 8) which similar to the previously described crank member **31** is supported in the bearings at **32** in Fig. 1. Oscillating motion is applied from the cam **40** and pendulous link **41** to the carrier **31***a* by means of pivoted yoke link **45***a*, equivalent to link **45** in Fig. 2.

Adjustment of the oscillating deflecting units can be effected by reason of the free passage of the securing bolts **55** through the yoke member of the clips **54**.

For convenience in describing the light deflecting functions to be performed by the arrangements described of an oscillating deflector unit and a rotating deflector unit, reference will now be made to the diagrammatic view designated Fig. 10.

In this diagram the oscillating deflecting surfaces are shown located at OD, and designated A, B, C, the rotating deflecting surfaces at RD are designated K, L, M, N, and a single source of light is indicated at L.

The signal light beam SB proceeding from L and directed by lens CL is angularly incident upon the axis of oscillation of the surfaces A, B, C, and embraces an overall area at said surfaces as indicated by dotted line DL, the beams *a, b, c,* deflected from said surfaces A, B, C, having approximately uniform angular velocity and constituting divisions of the single light beam SB.

The latter beams *a, b, c,* are directed coincidently to an area at RA about the axis at **0** (corresponding to the axis of the spindle **51** in Fig. 2) about which axis **0** rotate the deflecting surfaces K, L, M, N (designated **52** in Fig. 2), the light beams *ak, bk,* and *ck* from the latter proceeding to a viewing screen or light sensitive cell at S. To obviate crowding the diagram the beams from the deflecting surfaces L, M and N have been shown broken away adjacent said surfaces.

It will be appreciated that if the source of light at L is moving in a path angularly related to the direction of motion of the beam set up by the rotary deflector at RD whereby the two angularly related motions previously described for the performance of scanning are set up, then the reflecting surfaces **13** will not require to be oscillated.

Similarly if the light reflected from the rotating surfaces **52** continually traces the same line across a travelling screen, such as a picture film, the effect obtained is the same as the movement of the beam relative to a fixed screen as above described.

The apparatus described is applicable for use in monitoring work at the transmitter by suitably positioning a modulated source of light and directing the light therefrom to the oscillating and the rotary deflecting units as before described, and thence to a monitor screen for observation of the quality of the picture transmission.

The various adjustments provided for the oscillating reflecting surfaces **13** as before described permit of accurate direction of the beams from the deflecting surfaces **13** and **52** and to the location at S of a viewing screen or light sensitive cell.

I claim:

1. In television transmission and receiving systems having a screen, a scanning device comprising a deflector unit consisting of a plurality of deflecting surfaces mounted on a common oscillatory axis normal to the plane of oscillation, means for projecting a single beam of light on said deflecting surfaces, said unit operating to divide said beam into a plurality of light beams, and a rotating deflector unit consisting of a plurality of deflectors presenting deflecting surfaces radially disposed about and arranged along a common axis, said rotating deflector unit being rotatable on an axis located at right angles to said common oscillatory axis, whereby said oscillatory and rotating deflecting surfaces coact to cause the beams of light deflected therefrom to trace in cyclical order a series of substantially parallel lines on a viewing screen.

2. In television transmission and receiving systems according to claim 1, in which the first deflector unit, consisting of a plurality of deflecting surfaces on which the single beam of light is incident, is mounted for oscillatory motion whereby the beams of light proceeding therefrom are caused to move in opposite directions along a common path upon the deflecting surfaces of the rotating deflector unit, said path being coincident with and along the axis of rotation of said deflecting surfaces.

3. In television transmission and receiving systems according to claim 1, in which each of the opposite sides of each deflector of the rotating deflector unit presents a deflecting surface.

4. In television transmission and receiving systems having a screen, a scanning device comprising a first deflector unit consisting of a plurality of deflecting surfaces, mounted on a common oscillatory axis normal to the plane of oscillation, means for projecting a single beam of light on said deflecting surfaces, said unit operating to divide said beam into a plurality of light beams, a rotating deflector unit consisting of a plurality of deflectors presenting deflecting surfaces radially disposed about and arranged along a common axis, said rotating deflector unit being rotatable on an axis located at right angles to said common oscillatory axis, whereby said oscillatory and rotating deflecting surfaces coact to cause the beams of light deflected therefrom to trace in cyclical order a series of substantially parallel lines on a viewing screen, means for mounting said first deflector unit, which unit consists of a plurality of deflecting surfaces on which the single beam of light is incident, for oscillatory motion whereby the beams of light proceeding therefrom are caused to move in opposite directions along a common path upon the deflecting surfaces of the rotating deflector unit, said path being coincident with and along the axis of rotation of said deflecting surfaces, said mounting means consisting of a cranked member mounted in aligned bearings with the axis of the latter coincident with the axis of oscillation of said deflecting surfaces, and means for adjustably securing the deflecting surfaces upon said cranked member.

5. In television transmission and receiving systems having a screen, a scanning device comprising a first deflector unit consisting of a plurality of deflecting surfaces mounted on a common oscillatory axis normal to the plane of oscillation, means for projecting a single beam of light on said deflecting surfaces, said unit operating to divide said beam into a plurality of light beams, a rotating deflector unit consisting of a plurality of deflectors presenting deflecting surfaces radially disposed about and arranged along a common axis, said rotating deflector unit being rotatable on an axis located at right angles to said common oscillatory axis, whereby said oscil-

latory and rotating deflecting surfaces coact to cause the beams of light deflected therefrom to trace in cyclical order a series of substantially parallel lines on a viewing screen, means for mounting said first deflector unit, which unit consists of a plurality of deflecting surfaces on which the single beam of light is incident, for oscillatory motion whereby the beams of light proceeding therefrom are caused to move in opposite directions along a common path upon the deflecting surfaces of the rotating deflector unit, said path being coincident with and along the axis of rotation of said deflecting surfaces, said mounting means consisting of a cranked member mounted in aligned bearings with the axis of the latter coincident with the axis of oscillation of said deflecting surfaces, a plate for each deflecting surface carried on the crank, a carrier for each deflecting surface, and means for adjustably mounting each carrier on a corresponding plate.

6. In television transmission and receiving systems having a screen, a scanning device comprising a first deflector unit consisting of a plurality of deflecting surfaces mounted on a common oscillatory axis normal to the plane of oscillation, means for projecting a single beam of light on said deflecting surfaces, said unit operating to divide said beam into a plurality of light beams, a rotating deflector unit consisting of a plurality of deflectors presenting deflecting surfaces radially disposed about and arranged along a common axis, said rotating deflector unit being rotatable on an axis located at right angles to said common oscillatory axis, whereby said oscillatory and rotating deflecting surfaces coact to cause the beams of light deflected therefrom to trace in cyclical order a series of substantially parallel lines on a viewing screen, means for mounting said first deflector unit, which unit consists of a plurality of deflecting surfaces on which the single beam of light is incident, for oscillatory motion whereby the beams of light proceeding therefrom are caused to move in opposite directions along a common path upon the deflecting surfaces of the rotating deflector unit, said path being coincident with and along the axis of rotation of said deflecting surfaces, said mounting means consisting of a frame pivotally mounted in aligned bearings with the axis of the latter coincident with the axis of oscillation of said deflecting surfaces, and means for securing said deflecting surfaces in said frame.

7. In television transmission and receiving systems having a screen, a scanning device comprising a first deflector unit consisting of a plurality of deflecting surfaces mounted on a common oscillatory axis normal to the plane of oscillation, means for projecting a single beam of light on said deflecting surfaces, said unit operating to divide said beam into a plurality of light beams, a rotating deflector unit consisting of a plurality of deflectors presenting deflecting surfaces radially disposed about and arranged along a common axis, said rotating deflector unit being rotatable on an axis located at right angles to said common oscillatory axis, whereby said oscillatory and rotating deflecting surfaces coact to cause the beams of light deflected therefrom to trace in cyclical order a series of substantially parallel lines on a viewing screen, means for mounting said first deflector unit, which unit consists of a plurality of deflecting surfaces on which the single beam of light is incident, for oscillatory motion whereby the beams of light proceeding therefrom are caused to move in opposite directions along a common path upon the deflecting surfaces of the rotating deflector unit, said path being coincident with and along the axis of rotation of said deflecting surfaces, said mounting means consisting of a cranked member mounted in aligned bearings with the axis of the latter coincident with the axis of oscillation of said deflecting surfaces, means for adjustably securing the deflecting surfaces upon said cranked member, a continuously rotating cam, and means including a cam follower linked to said crank for transmitting oscillatory motion to said crank.

8. In television transmission and receiving systems having a screen, a scanning device comprising a first deflector unit consisting of a plurality of deflecting surfaces mounted on a common oscillatory axis normal to the plane of oscillation, means for projecting a single beam of light on said deflecting surfaces, said unit operating to divide said beam into a plurality of light beams, a rotating deflector unit consisting of a plurality of deflectors presenting deflecting surfaces radially disposed about and arranged along a common axis, said rotating deflector unit being rotatable on an axis located at right angles to said common oscillatory axis, whereby said oscillatory and rotating deflecting surfaces coact to cause the beams of light deflected therefrom to trace in cyclical order a series of substantially parallel lines on a viewing screen, means for mounting said first deflector unit, which unit consists of a plurality of deflecting surfaces on which the single beam of light is incident, for oscillatory motion whereby the beams of light proceeding therefrom are caused to move in opposite directions along a common path upon the deflecting surfaces of the rotating deflector unit, said path being coincident with and along the axis of rotation of said deflecting surfaces, said mounting means consisting of a cranked member mounted in aligned bearings with the axis of the latter coincident with the axis of oscillation of said deflecting surfaces, means for adjustably securing the deflecting surfaces upon said cranked member, a continuously rotating cam, and means including a cam follower linked to said crank for transmitting oscillatory motion to said crank, said cam being contoured to ensure uniform linear velocity of the incident ends of the beams of light deflected from the deflecting surfaces mounted on said crank member and in opposite directions on said screen and parallel to the axis of rotation of the rotating deflector unit.

9. In television transmission and receiving systems having a screen, a scanning device comprising a deflector unit consisting of a plurality of deflecting surfaces mounted on a common oscillatory axis normal to the plane of oscillation, means for projecting a single beam of light on said deflecting surfaces, said unit operating to divide said beam into a plurality of light beams, a rotating deflector unit consisting of a plurality of deflectors presenting deflecting surfaces radially disposed about and arranged along a common axis, said rotating deflector unit being rotatable on an axis located at right angles to said common oscillatory axis, whereby said oscillatory and rotating deflecting surfaces coact to cause the beams of light deflected therefrom to trace in cyclical order a series of substantially parallel lines on a viewing screen, means for mounting the deflecting surfaces of said rotating deflector unit, consisting of a casing surrounding said deflecting surfaces, and clips engaging the ends of

the deflectors for adjustably securing said deflectors within the casing.

10. In television transmission and receiving systems having a screen, a scanning device comprising a deflector unit consisting of a plurality of deflecting surfaces mounted on a common oscillatory axis normal to the plane of oscillation, means for projecting a single beam of light on said deflecting surfaces, said unit operating to divide said beam into a plurality of light beams, a rotating deflector unit consisting of a plurality of deflectors presenting deflecting surfaces radially disposed about and arranged along a common axis, said rotating deflector unit being rotatable on an axis located at right angles to said common oscillatory axis, whereby said oscillatory and rotating deflecting surfaces coact to cause the beams of light deflected therefrom to trace in cyclical order a series of substantially parallel lines on a viewing screen, means far mounting the deflecting surfaces of said rotating deflector unit, consisting of a casing surrounding said deflecting surfaces, and clips engaging the ends of the deflectors for adjustably securing said deflectors within the casing, said clips including arms embracing the deflectors and flexible struck-out elements for mounting the same on the casing.

11. In television transmission and receiving systems having a screen, a scanning device comprising a first deflector unit consisting of a plurality of deflecting surfaces mounted on a common oscillatory axis normal to the plane of oscillation, means for projecting a single beam of light on said deflecting surfaces, said unit operating to divide said beam into a plurality of light beams, a rotating deflector unit consisting of a plurality of deflectors presenting deflecting surfaces radially disposed about and arranged along a common axis, said rotating deflector unit being rotatable on an axis located at right angles to said common oscillatory axis, whereby said oscillatory and rotating deflecting surfaces coact to cause the beams of light deflected therefrom to trace in cyclical order a series of substantially parallel lines on a viewing screen, means for mounting said first deflector unit, which unit consists of a plurality of deflecting surfaces on which the single beam of light is incident, for oscillatory motion whereby the beams of light proceeding therefrom are caused to move in opposite directions along a common path upon the deflecting surfaces of the rotating deflector unit, said path being coincident with and along the axis of rotation of said deflecting surfaces, and means for adjustably securing the deflecting surfaces upon said mounting means.

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