350-6.3 SR
XR 2,023,217
TX 3022T
ADDED

Dec. 3, 1935. F. A. BENFORD 2,023,217

TELEVISION SCANNING APPARATUS

Filed May 11, 1933 2 Sheets-Sheet 1

Fig. 1.

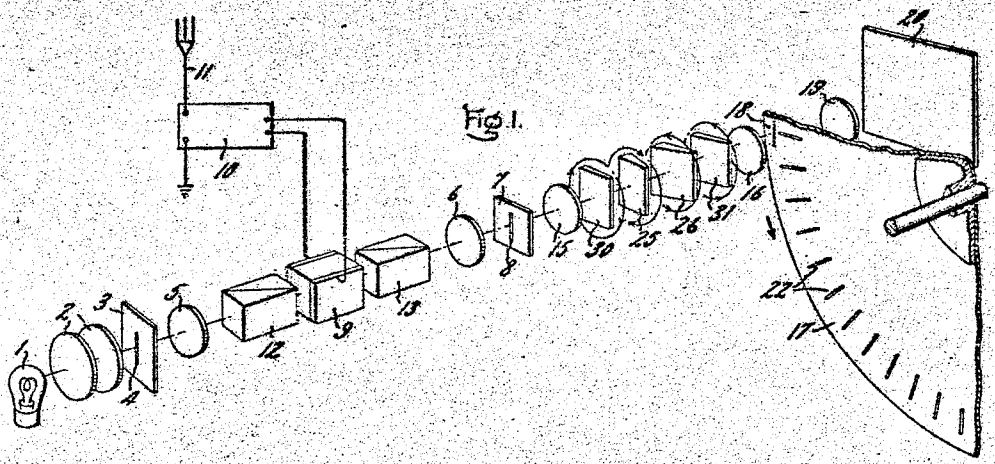
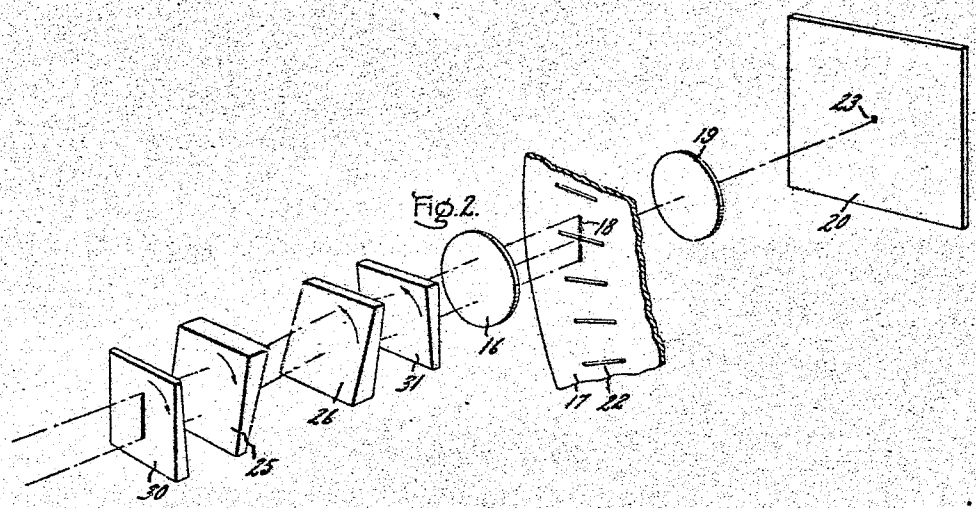


Fig. 2.



Inventor:
Frank A. Benford,
by Charles E. Tuttle
His Attorney.

2023217
NO OR CLASSIF

Dec. 3, 1935. F. A. BENFORD 2,023,217

TELEVISION SCANNING APPARATUS

Filed May 11, 1933 2 Sheets-Sheet 2

Fig. 3.

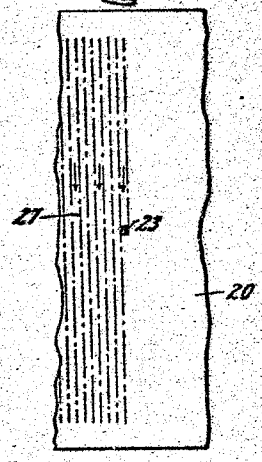


Fig. 4.

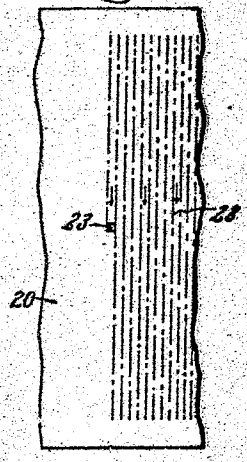


Fig. 6.

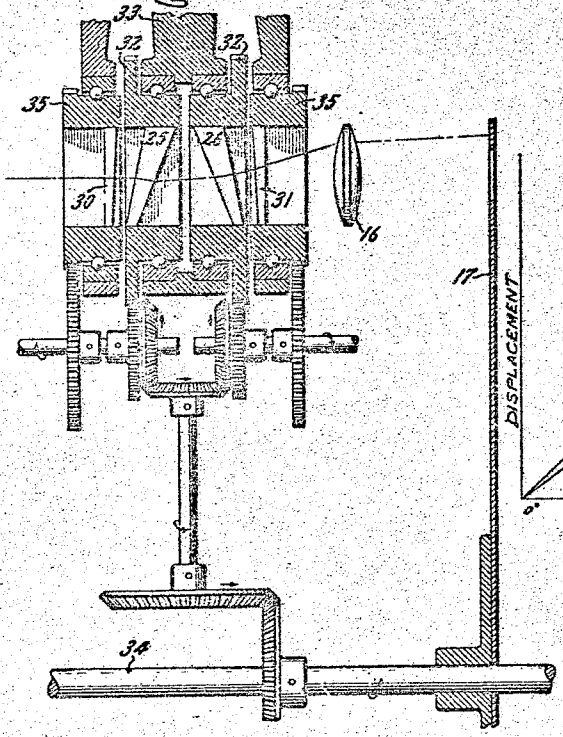
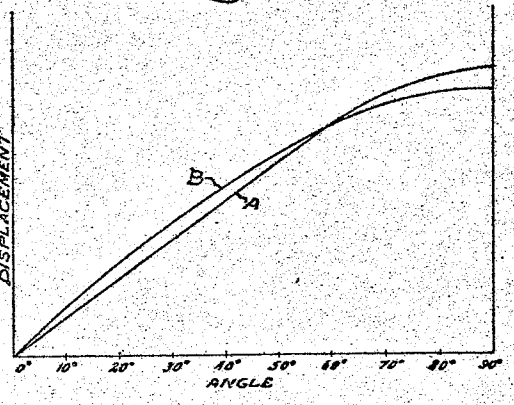


Fig. 5



Inventor:
Frank A. Benford,
by Charles E. Fuller
His Attorney.

Patented Dec. 3, 1935 2,023,217

UNITED STATES PATENT OFFICE

2,023,217

TELEVISION SCANNING APPARATUS

Frank A. Benford, Schenectady, N. Y., assignor to General Electric Company, a corporation of New York

Application May 11, 1933, Serial No. 670,491

10 Claims. (Cl. 178—6)

My invention relates to television scanning apparatus of the type in which the scanning is done in lines extending across the view or screen to be scanned. One object of my invention is to provide an improved scanning apparatus of this type wherein the appearance of streaks in the reproduced picture due to improper spacing of the scanning lines is partially if not entirely eliminated. Another object is to provide an improved scanning apparatus of this type wherein substantially uniform spacing of the scanning lines is obtained throughout the picture.

My invention will be better understood from the following description taken in connection with the accompanying drawings, and its scope will be pointed out in the appended claims.

Referring to the drawings, Fig. 1 is a combined diagrammatic and perspective view of one form of apparatus embodying my invention; Fig. 2 shows a limited portion only of the apparatus illustrated by Fig. 1, drawn to a larger scale and with the parts in a different position; Figs. 3 and 4 illustrate portions of the picture receiving screen showing the two sets of scanning lines; in Fig. 5 are shown curves illustrating the effect of the apparatus embodied in my invention; and Fig. 6 is a plan in cross section of the prism mounting and rotating means forming a part of my invention.

Although my invention is applicable both to the television transmitter and to the receiver I have chosen to illustrate it as forming a part of a television receiver. In this receiver light from a suitable source 1 is condensed by the condensing lenses 2 upon the diaphragm 3 having therein the vertical slit 4. The illuminated slit 4 becomes a secondary light source and is imaged by means of the collimating lenses 5 and 6 upon a second diaphragm 7 having therein a vertical slit 8 corresponding to the slit 4. Between the lenses 5 and 6 the light extends substantially in parallel rays where it is controlled by the received television signal. Various well known means may be employed to control the light in accordance with the signals. In the present case I have illustrated a Kerr cell 9 as the controlling element which is shown connected through a suitable amplifier 10 with a radio antenna 11 and at opposite sides of the Kerr cell and in the optical axis of the apparatus are the polarizing prisms 12 and 13. While the diaphragm 7 having the slit 8 is not absolutely essential it is useful in sharpening the image by cutting off the stray light due to imperfections in the lenses and particularly due to the Kerr cell. A second pair of collimating lenses 15 and 16 between which the rays extend substantially parallel serve to image the light slit 8 upon the rotatable scanning disk 17. Such an image is shown at 18 where in Fig. 1 it is shown deflected to one extreme position by means of the prisms to be described later. By means of those prisms the image 18 is caused to vibrate laterally and beyond the disk in the optical axis of the apparatus is the projecting lens 19 by which an enlargement of image 18 is projected on the picture receiving screen 20. Were it not for the disk 17 the image projected on the screen 20 would have substantially the same length as the screen and would sweep laterally across the entire screen. Disk 17 is provided with a number of radial slots 22 which are spaced apart a distance approximately equal to the length of the image 18 and the disk rotates at a speed such that during the movement of each slot through the length of the image 18 the image moves laterally a distance equal to its own width. The width of the slots 22 is approximately the same as the width of the image 18, hence at the point of intersection of a slot and the image a light beam of approximately square cross section passes through the disk and is projected as a light spot on the screen 20. Such a spot is shown at 23 in Figs. 2, 3, and 4.

The means which I have provided for producing a lateral movement of the image 18 comprises in part the two similar oppositely rotating prisms 25 and 26. These two prisms are mounted on the same axis, namely, the optical axis of the system and are rotated in opposite directions at the same speed. As shown in Fig. 1 when the two main prisms 25 and 26 have their bases in corresponding positions the image 18 is deflected a maximum in the corresponding position. When the bases of these prisms are in opposite positions, as shown for example in Fig. 2, the image 18 is in its mid-position. Hence each complete rotation of these prisms causes the image to make one complete traversal and return to its original position. The combined effect of the movement of the slots 22 of disk 17 and the movement of image 18 toward the right as seen in Fig. 1 causes the light spot 23 to scan the screen 20 in a series of narrow zones 27, termed "lines" in the art, which are slightly inclined to the vertical, as shown in Fig. 3. Likewise on the return movement of the image 18 the light spot 23 will scan the screen in a series of zones or lines 28 which are inclined to the vertical in the opposite direction. The inclination of the scanning lines of each set is slight so that the lines of the two

sets make a relatively small angle with each other. By thus scanning the screen alternately by means of two sets of relatively inclined lines I obtain a distinct advantage. It is well known that with television apparatus heretofore constructed the pictures often show light or dark streaks or both extending in the direction of the scanning lines. The light streaks may be due to an overlapping of the lines and the dark streaks may be due to too great a spacing between lines. By scanning the screen successively with two sets of scanning lines, the lines of one set being inclined slightly to those of the other as with the above described apparatus, I am able to avoid largely if not entirely light and dark streaks due to improper spacing of the successive lines since the crossing of the lines of one set over those of the other set at a small angle tends to conceal or wash out the streaks which otherwise might appear.

Inasmuch as the main prisms 25 and 26 rotate with a uniform motion the image 18 moves laterally with harmonic motion; hence the image at the middle of its path of travel moves at a materially higher rate of speed than it does adjacent either end thereof. If the successive scanning lines in the central portion of the picture are so spaced that dark streaks are avoided the picture at either side where the lines overlap due to the slower transverse speed of the image will be materially brighter than at the central portion. In order to avoid this inequality in the brightness of the picture between the central and the two side portions I have provided the two auxiliary prisms 30 and 31 which are rotated in opposite directions as indicated by the arrows and at a speed which is three times that of the speed of rotation of the main prisms. The effect of the auxiliary prisms 30 and 31 is to cause a decrease in the lateral movement of the image 18 while the image is in its central position and to cause an increase in the movement of the image when the same is adjacent either end of its path. The combined effect of the main and auxiliary prisms is to cause the image to move laterally with a substantially uniform movement throughout its travel except at the extreme ends. To illustrate the effect of the two sets of prisms I have shown in Fig. 5 curve A plotted between displacement of the image 18 from its center position and the angle of rotation of the prisms which line it will be noted is substantially straight up to approximately 70°. In comparison with this line I have shown by the curve B the movement of the image which would result from the use merely of the main prisms 25 and 26. As illustrated in the drawings the auxiliary prisms 30 and 31 are relatively weak, the amplitude of the third harmonic which they produce being only 7½% of the amplitude of the first harmonic produced by the main prisms. Since as pointed out above the image 18 has a substantially uniform speed throughout approximately 70° of the movement of the prisms any objectionable appearance in the picture at the extreme side portions may be eliminated by screening off those portions of the picture. This is automatically done with the apparatus shown in Fig. 1 since the length of the slots 22 is somewhat less than the full swing of image 18.

In Fig. 6 I have shown by way of illustration one form of mounting and driving apparatus for the various prisms. The two main prisms are shown each mounted in a separate ring 32 which is supported by means of ball bearings in a frame 33 and by means of suitable spur and bevel gearing are rotated in opposite directions at the same speed from the main shaft 34. Likewise the auxiliary prisms 30 and 31 are mounted in rings 35 which are supported also by ball bearings and which are rotated in opposite directions through spur gearing driven from the aforementioned gearing. The gearing for driving the auxiliary prisms is so constructed that those prisms are driven at exactly three times the speed at which the main prisms are driven. Secured to the main shaft 34 is the scanning disk 17 whereby the speed of the latter is fixed relatively to the speed of the prisms. It will be noted (see in particular Fig. 6) that main prisms 25 and 26 are inclined to the optical axis of the apparatus. I have found it necessary to provide such inclination of the main prisms in order to avoid longitudinal shifting of the image 18 due to the rotation of those prisms. While such longitudinal movement of the image 18 may be tolerated it can easily be avoided by a suitable inclination of the main prisms in their supporting rings as shown.

I have chosen the particular embodiment described above as illustrative of my invention and it will be apparent that various other modifications may be made without departing from the spirit and scope of my invention which modifications I aim to cover by the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. Television scanning apparatus comprising means for projecting a spot of light on a member to be scanned, means for moving said spot uniformly across said member in one direction, a plurality of prisms in the path of said light mounted for rotation on a common axis for moving said spot across the member in a different direction and means in the path of said light for modifying the speed of the spot in said different direction whereby its resulting movement in the different direction is substantially uniform.

2. Television scanning apparatus comprising a fixed light slit, means for illuminating said slit, means for producing an image of said slit, means for moving said image with substantially uniform speed alternately in opposite transverse directions and a rotatable disk having a series of slots arranged successively to intersect said image.

3. Television scanning apparatus comprising a member having a light slit therein, a plurality of prisms in the path of light passing said slit, means for rotating said prisms in opposite directions and a disk having a series of slots therein arranged successively to intersect said path and extending substantially at right angles to said slit at the point of intersection.

4. Television scanning apparatus comprising means for projecting a spot of light on a member to be scanned, means for moving said spot uniformly across said member in one direction, a plurality of prisms in the path of said light, means for rotating said prisms in opposite directions on a common axis whereby the spot is moved across the member in a different direction and means for increasing the speed of the spot in said different direction at opposite sides of the member relative to its speed at intermediate portions thereof.

5. Television scanning apparatus comprising means for projecting a spot of light on a member to be scanned, means for moving said spot uniformly across said member in one direction, a plurality of prisms in the path of said light, means for rotating said prisms in opposite direc-

tions on a common axis whereby the spot is moved across the member in a different direction and means including other prisms for decreasing the speed of the spot in said different directions at a part of the member intermediate the opposite side portions thereof relative to its speed at said side portions.

6. Television scanning apparatus comprising means for projecting a spot of light on a member to be scanned, means for moving said spot uniformly across said member in one direction, a pair of similar prisms arranged in the path of said light, means for rotating said prisms in opposite directions on the same axis whereby the spot is moved at right angles to said direction and other rotatable prisms arranged in the path of said light for causing the spot to move at a more uniform speed in said right angle direction.

7. Television scanning apparatus comprising means for projecting a spot of light on a member to be scanned, means for moving said spot uniformly across said member in one direction, means for moving said spot across said member with harmonic motion at right angles to said direction and means for modifying said harmonic motion to produce a substantially uniform motion of the spot.

8. Television scanning apparatus comprising means for projecting a spot of light on a member to be scanned, means for moving said spot uniformly across said member in one direction, a plurality of prisms in the path of said light, means for rotating said prisms in opposite directions on a common axis whereby the spot is moved across the member in a direction at right angles to said direction with harmonic motion, and a plurality of prisms cooperating with said first prisms for changing the harmonic motion of said spot to a substantially uniform motion.

9. Television scanning apparatus comprising means for projecting a line of light on a member to be scanned, a plurality of rotatable prisms mounted on a common axis for moving said light line transversely across said member and a rotatable disk having a series of slots therein arranged to intersect said line at right angles.

10. Television scanning apparatus comprising means for projecting a line of light on a member to be scanned, a plurality of oppositely rotatable prisms in the path of said light, means for rotating said prisms in opposite directions, a plurality of other prisms in the path of said light, means for rotating said other prisms at three times the speed of the first mentioned prisms and a scanning disk having radial slots therein arranged successively to intersect said line at right angles.

FRANK A. BENFORD.