

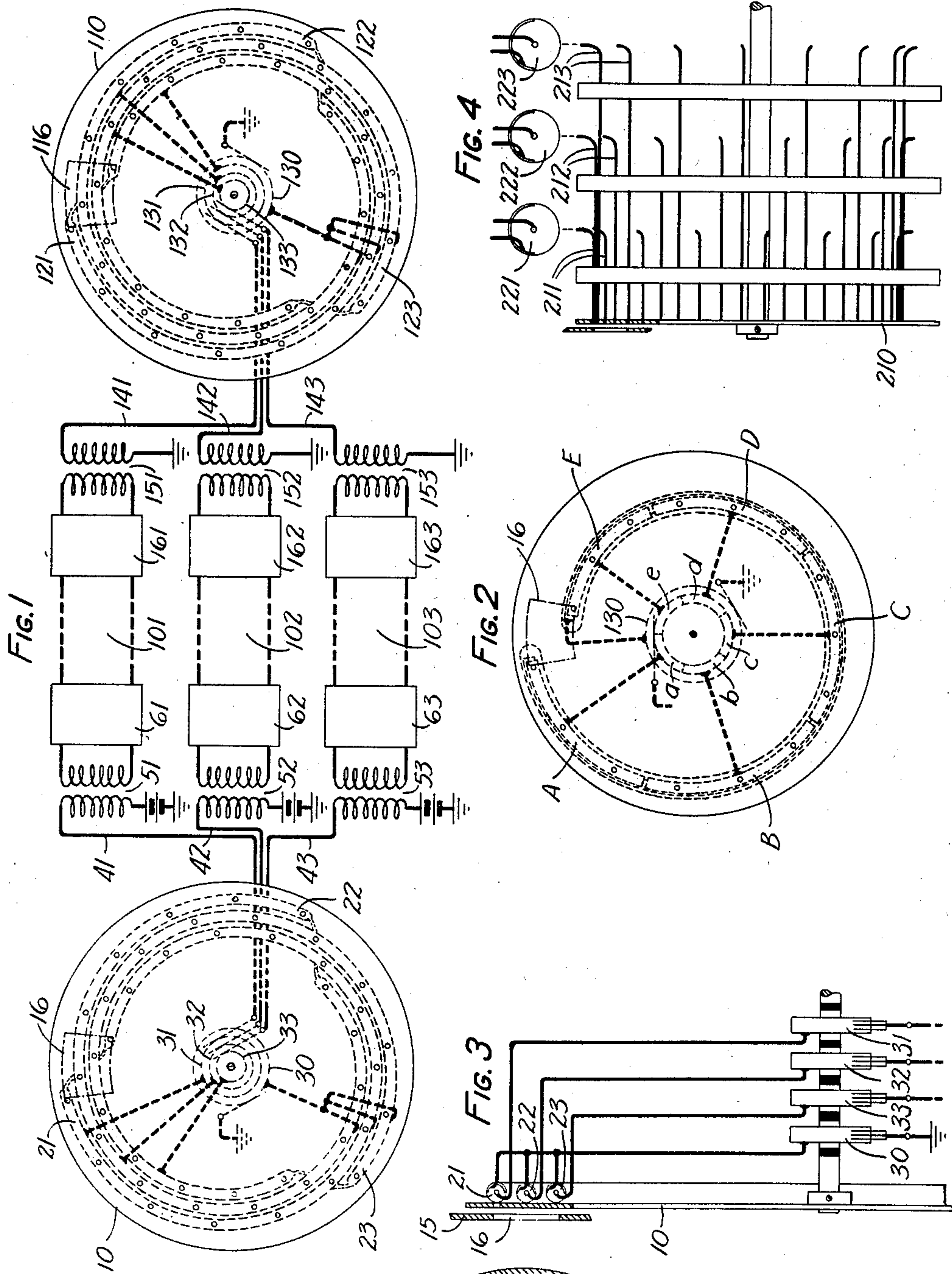
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O. B. BLACKWELL ET AL

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TELEVISION SYSTEM

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INVENTORS: O. B. BLACKWELL
 J. HERMAN
 BY *g e f o r*
 ATTORNEY

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TELEVISION SYSTEM

Otto B. Blackwell, Plandome, N. Y., and Joseph Herman, Westfield, N. J., assignors to American Telephone and Telegraph Company, a corporation of New York

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14 Claims. (Cl. 178—6)

This invention relates to electro-optical systems and more particularly to means for multiple channel transmission of images of still or moving objects or of pictures.

5 An object of this invention is to provide an improved scanning system and method for multiple channel operation with channels of limited frequency range.

10 Another object is to provide multi-channel image transmission in which several complete images are concurrently transmitted and produce a truly composite image or picture.

Other objects and advantages will be apparent from the following description.

15 In accordance with a preferred embodiment of the invention scanning means are provided comprising a scanning member such as a disc, having a plurality of sets of spirally arranged apertures, each set of apertures at the transmitting station being associated with a spirally shaped photoelectric cell. These spirally arranged apertures and their associated photoelectric cells for each channel have an annular length of approximately 360° and are interwoven or arranged in an interlocking fashion, that is, they are angularly displaced with reference to each other by approximately 360° divided by the number of channels, thus uniformly interlocking and distributing each set of apertures with reference to each other in a symmetrical arrangement. The total number of apertures in the scanning disc is equally divided among the several spirals, the latter equaling the number of channels. One aperture of each spiral is exposed to the field of view at all times and 35 these apertures, due to the above mentioned angular displacement, at any instant are uniformly spaced apart on the field of view.

A similar scanning member or disc is used at the receiving station but instead of spirally shaped light sensitive cells being associated with each set of apertures, similarly shaped light sources are employed.

45 Electrical connection is made with the moving light sensitive cells or light sources by means of a set of slip rings or commutators connected with the terminals of these elements and engaging stationary brushes.

50 The light sensitive cells or light sources are in the form of a unitary structure common to a plurality of apertures, preferably one for each channel, and as a result the vacuum or gas pressure of these elements is the same at all the apertures of a given channel. The chambers of all of the tubes may be interconnected so as to 55 obtain uniform vacuum or gas pressure throughout

out and separation of the several channels maintained by the electrical connections to separate electrodes segregated according to channels. If the connections with each of the light sources at the receiving station are made through slip rings, one per channel, then the signal current will cause generation of light throughout the whole tube for each channel, but if the slip rings are divided into segments and each segment connected to subdivided electrodes in the glow discharge tubes, then the generation of light may be limited to a small part of the light sources in the region opposite the viewing field.

It should be noted that the frequency range of each channel may be limited as desired notwithstanding the fact that each channel transmits the entire field for television operation. The rate at which each channel transmits the entire field and view is

$$\frac{k}{n} \quad 20$$

where k is the rate at which the image of the field must be transmitted for satisfactory television and n the number of channels in the system. As a result, for a field of a given size the frequency range required per channel is reduced in proportion to the number of channels simultaneously employed and the received composite image resulting from combining the separate images transmitted over each of the different channels at the slower rate of

$$\frac{k}{n} \quad 25$$

has the appearance as if it had been transmitted over a single channel at a higher rate of k with a wide frequency range equal to the total of that of all of the channels employed in the multiple channel transmission.

40 The channels may consist of ordinary telephone circuits or open wire lines or cables, carrier telephone channels or radio channels obtained by using different radio carrier frequencies for each channel or a radio channel obtained by stepping up the frequency of the various photoelectric channels to different parts of the frequency spectrum and transmitting the entire group of frequencies by means of a single radio carrier frequency.

50 Another arrangement for carrying out the principles of this invention in which the entire field of view is scanned for each channel consists of scanning discs having quartz rods or the equivalent associated with each of the apertures and so bent or arranged that the light is directed 55

to stationary light sensitive cells, each cell representing a different channel in the transmitting station, or from stationary light sources, each light source representing a different channel in the receiving station. This arrangement has the advantage of permitting the transmitted electrical energy to be used in small light sources, one per channel, and thus concentrate the production of light for each channel.

A more detailed description of the invention follows and is illustrated in the accompanying drawing.

Fig. 1 is a general schematic representation of the transmitting and the receiving terminal apparatus connected by multiple channel transmission lines.

Fig. 2 shows a commutating arrangement for limiting the lighted area of the glow discharge tubes at any instant to a small portion of their length, one tube only being shown.

Fig. 3 shows a side and partial section view of the scanning disc, the spiral tubes mounted thereon and the electrical connections leading thereto.

Fig. 4 shows an alternative channelizing arrangement comprising means for deflecting the light rays passing through the scanning apertures for channelizing the light beams.

Referring to Fig. 1 the scanning disc 10 contains three sets of apertures arranged in the form of interwoven spirals, each spiral having an angular length of approximately 360° . The spirals are angularly disposed with reference to each other by approximately 360° divided by the number of channels, which in a three channel system cause a displacement of 120° . In this arrangement the spirals are uniformly interlocked and each set of apertures is symmetrically arranged with reference to the others. The total number of apertures in the scanning disc is equally divided among the several spirals. One aperture of each spiral is exposed to the field of view 16 at a time and these apertures, due to the above mentioned angular displacement, are at any instant uniformly spaced apart on the field of view. Large light sensitive cells 21, 22, and 23 are attached to the scanning disc and one is associated with each set of spirals. The containing vessels of these cells may be individual to each spiral or all may be interconnected so that the same vacuum exists in all, or they may be of even smaller size than required for a single spiral. One terminal of each cell is connected to a common slip ring 30. The other terminals of the cells associated with a given spiral are electrically connected together and to slip rings 31, 32, and 33, respectively. These connections result in commoning one side of all the photoelectric cells and grouping the other side according to channels. The common side is grounded and the other side is connected to the respective transmission lines by means of brushes associated with the several slip rings and the conductors 41, 42, and 43 leading respectively to the coupling element of each transmission line. A potential is impressed on the photoelectric cells by means of the batteries 44, 45, and 46. These circuits are coupled with the several transmission lines by means of the coupling transformers 51, 52, and 53. Suitable amplifiers and other terminal apparatus 61, 62, and 63 respectively, for impressing the signal current upon the transmission lines are employed.

Transmission lines 101, 102, and 103 interconnect the transmitting station with the receiving station. At the receiving station the different

signal currents are amplified by means of suitable receiving amplifiers 161, 162, and 163 which in turn are connected to the light sources through coupling transformers 151, 152, and 153 respectively and the conductors 141, 142, and 143.

The receiving scanning apparatus is similar to the transmitting scanning apparatus with the exception that light sources are employed instead of light sensitive cells. This apparatus consists of a scanning disc 110 having three sets of spirally arranged apertures arranged similar to those at the transmitting station. One aperture of each spiral is exposed to the field of view 116 at a time. Associated with each set of apertures and fixed to the scanning disc are a plurality of light sources 121, 122, and 123, each being associated with a respective spiral of apertures and a transmission channel. These light sources are preferably of the glow discharge type and the tubes associated with each spiral, while preferably separate and not interconnected, may be interconnected, so as to maintain uniform gas pressure throughout thus making all light sources operate with greater uniformity. One of the electrodes of all light sources is connected to a common conductor leading to a slip ring 130 which in turn is connected to ground. The other electrodes of all of the light sources are grouped according to channels and each such group is electrically connected to slip rings 131, 132, and 133 of the three channels, respectively.

In the arrangement shown in Fig. 1 the received signal current of each channel is impressed upon the whole tube spanning all of the apertures of a given channel thus illuminating the entire tube while the useful light is confined to only one aperture. The illuminated area may be limited to a smaller part if the slip rings are cut into commutator segments and each segment connected with the electrodes associated with a few of the apertures of each spiral. Such an arrangement is shown in Fig. 2, the slip rings 131, 132, and 133 being divided into commutator segments, *a*, *b*, *c*, *d*, and *e* and one set of electrodes of each light source spiral being divided into a corresponding number of sections A, B, C, D, and E, each of which is connected with one segment of the commutator. The other terminals of the light sources are all connected to the common slip ring 130. A tube for only one spiral and its connections are shown so as to avoid complicating the drawing. In this arrangement only a small portion of the light source in any spiral is energized and lighted at a given instant. The brushes connected with the commutators are so positioned that the segment energized is that connected to the sector of the lamp opposite the viewing field or window 16. Similar division of the light sensitive cells at the transmitting station may be made by use of a commutating device similar to that shown in Fig. 2 if so desired.

Means for operating the scanning apparatus at the transmitting and receiving stations in synchronism and in phase are not shown but any well known system may be employed.

A side and partial section view of the scanning disc, the spiral tubes mounted thereon and the electrical connections leading thereto are shown in Fig. 3. While the drawing shows specifically the arrangement at the transmitting station, the tubes being shown as light sensitive cells, the general arrangement is applicable to the receiving station requiring primarily a change in the interior of the tubes to convert them into glow discharge lamps. This figure also shows an objective

lens 14 for projecting an image of the object being scanned at the transmitting station upon the scanning area of the scanning disc 10 and the plate 15 containing an opening or window 16 bounding the scanning area. The spirally arranged tubes 21, 22, and 23 affixed to the scanning disc 10 are shown in cross section and one of their electrodes is connected in common to the slip ring 30 while the other electrode for each spiral or channel is individually connected to slip rings 31, 32, and 33 respectively. Connection from one of these last mentioned slip rings is made to the respective transmission channels as heretofore explained in the description of Fig. 1.

15 An alternative arrangement for channelizing the light is shown in Fig. 4. A scanning disc 210 contains a plurality of apertures arranged in the form of spirals similar to those shown in Fig. 1 and associated with each aperture is a quartz rod 211, 212, and 213 for the different channels for directing the light to one of the light sensitive cells 221, 222, and 223 or to one of the light sources associated with each of the respective channels at a transmitting station or a receiving station, respectively. In place of the quartz rods, tubes having reflecting interior surfaces, or other light directing means may be used. This arrangement permits the use of fixed light sensitive cells or fixed light sources, but it involves deflecting or bending of the light paths to cause channelization instead of position relation and direct passing of the light as shown in the previously described arrangement.

As heretofore stated and as shown in the drawing, one aperture of each spiral is in front of the viewing field or window at all times and the light passing through each of these apertures is associated with a different channel. Also these apertures are preferably so angularly positioned that they travel across the field with a uniform spacing, although the more important feature is that of uniform radial separation at all positions so that as the first third of the apertures of a given spiral is scanning the top third of the field the second third of the second spiral is scanning the second third of the field and the last third of the third spiral is scanning the last third of the field, and so on. Each third of the field is scanned at a rate which is within the time of the persistence of vision. In the second third of a revolution of the scanning disc each spiral is scanning the next third of the field and in the last third of a revolution, each spiral is scanning the succeeding third of the field. This results in each channel scanning and transmitting image currents of the entire field with the result that each channel transmits a complete image which at the receiving station is superimposed upon that of the images transmitted by the other channels and a truly composite picture produced. The rate of rotation of the scanning disc is cut down, compared with a single channel system, in proportion to the number of channels simultaneously employed. In the three-channel system the rate of rotation is one-third that required for a single channel system. The same results are obtainable from the scanning arrangements shown in either Fig. 1 or Fig. 4.

What is claimed is:

70 1. The method of limiting the frequency range required for each channel in multi-channel electro-optical transmission which comprises concurrently and repeatedly scanning the entire area of the same field of view for the different channels, a scanning of a given elemental area

for each channel taking place later than a scanning of that area for a different channel by a period approximately equal to each scanning period divided by the number of channels.

2. The method of multi-channel television which comprises concurrently and repeatedly scanning the entire area of the same field of view for the different channels, a scanning of a given elemental area for each channel taking place at a period later than a scanning of that area for a different channel by a period approximately equal to that of the persistence of vision.

3. A television system comprising a plurality of transmission channels and means associated with each channel for repeatedly concurrently scanning the field of view and for causing a scanning of a given elemental area for one channel to take place at a time later than that of an elemental area in the same region of the field for another channel by a period approximately equal to the period of persistence of vision.

4. A multiple channel electro-optical system comprising an apertured scanning disc having a plurality of sets of spirally arranged apertures and a spirally shaped light sensitive element associated with each of said sets of spirally arranged apertures arranged in interlocking positions and having in operation a phase displacement equal to a complete individual scanning cycle divided by the number of said sets of spirally arranged apertures.

5. A rotatable apertured scanning element having a row of spaced apertures and a single photoelectric cell conforming to the shape of said row of apertures and means for rotating said cell in fixed relation with said scanning element.

6. A rotatable scanning element having a plurality of overlapping rows of apertures, a corresponding plurality of elongated photoelectric cells each conforming in shape to one of said rows of apertures and cooperating therewith and means for rotating said cells in fixed relation with said scanning element.

7. The method of producing a television image which comprises producing a plurality of similarly placed images of the same field of view, each image being produced in a period greater than that of the persistence of vision and the production of said images being overlapping in time.

8. A multiple channel electrooptical system comprising an apertured scanning disc having a plurality of sets of spirally arranged apertures and spirally shaped lamps associated with said sets of spirally arranged apertures respectively to move therewith.

9. A television image producing system comprising a rotatable scanning element, a plurality of spirally shaped lamps attached thereto and rotating therewith, and means for continuously connecting each of said lamps to a respective input circuit.

10. Television scanning means comprising a rotatable member, a plurality of tubular lamps each of length many times its greatest transverse dimension, means for fixedly associating said lamps to said rotatable element with the longitudinal axes of said lamps lying along parallel curved lines, and means in part stationary and in part movable for conducting image currents to said lamps.

11. Television scanning apparatus including a spiral photo-electric tube, means for rotating said tube about its axis, and means for screening all of said tube at any instant except a single elemental scanning area thereof.

12. Television scanning apparatus including an electro-optical translation device arranged in the shape of a spiral tube, means for rotating said tube about its axis, and means for screening
5 all of said tube at any instant except a single elemental scanning area thereof.

13. Image producing means comprising a series of strip light sources, and means for simultaneously energizing a plurality of said light
10 sources to constitute remotely spaced unit lines of the image and for successively energizing all of said sources.

14. Image producing apparatus comprising a plurality of strip light sources, terminal means for a plurality of image current channels, means for distributing image currents from each of said
5 terminal means to respective ones of a group of said light sources, and optical scanning means for rendering effective at each instant the light from a single elemental area of each of said light sources then associated with said terminal means.

OTTO B. BLACKWELL.
JOSEPH HERMAN.