Aug. 20, 1935. A. McL. NICOLSON 2,011,947

TELEVISION SYSTEM

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FIG. 1

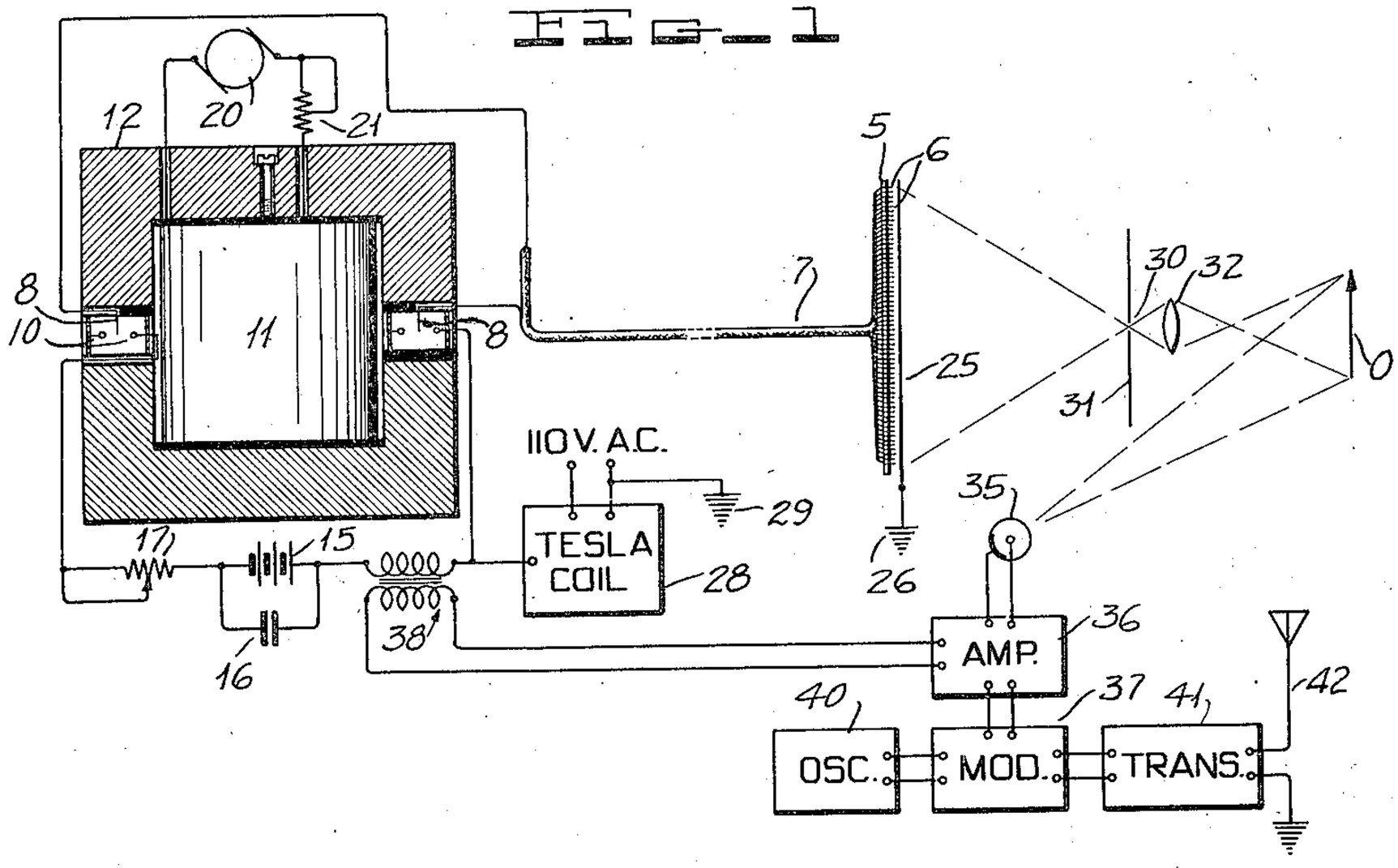

FIG. 2

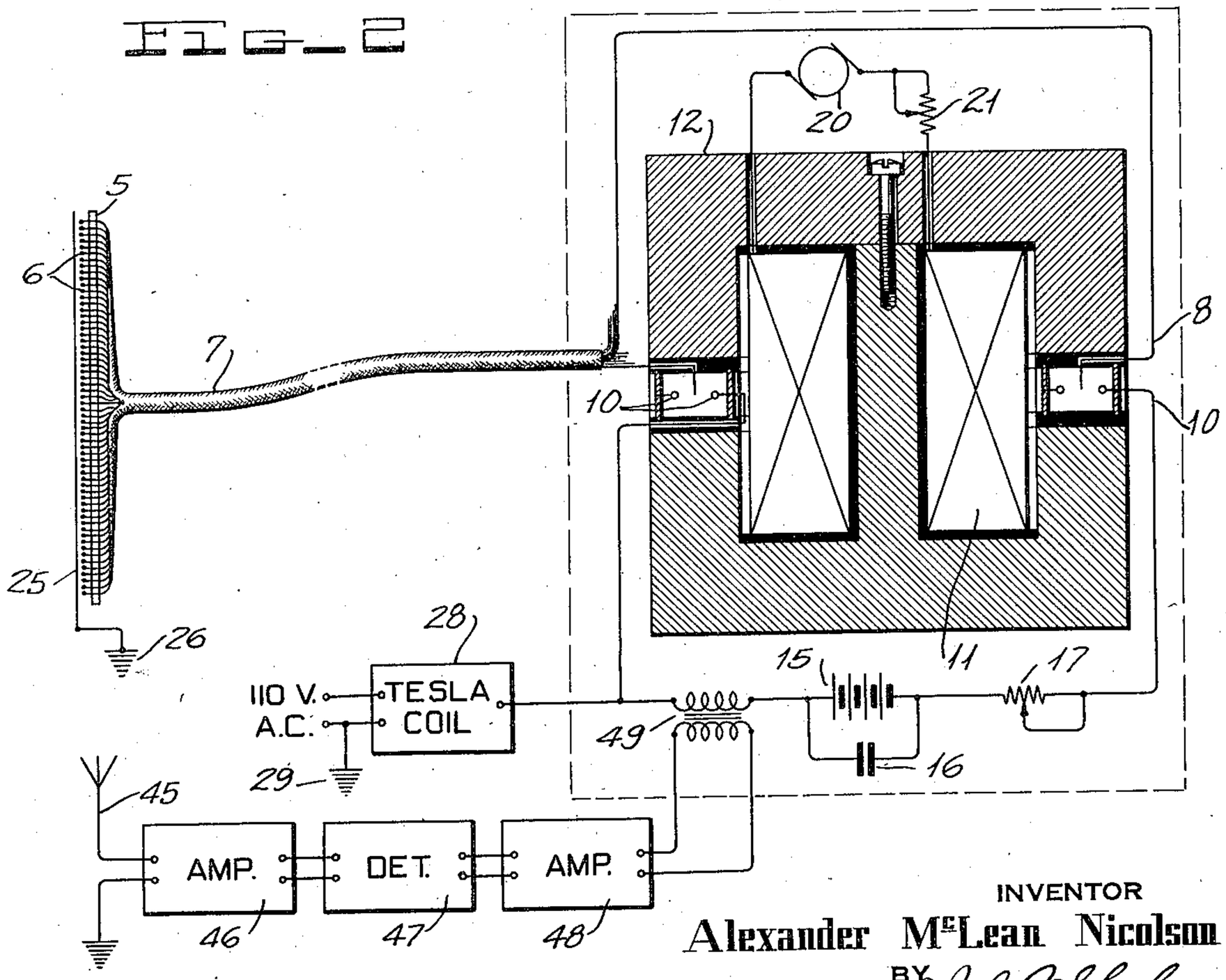

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FIG. 3

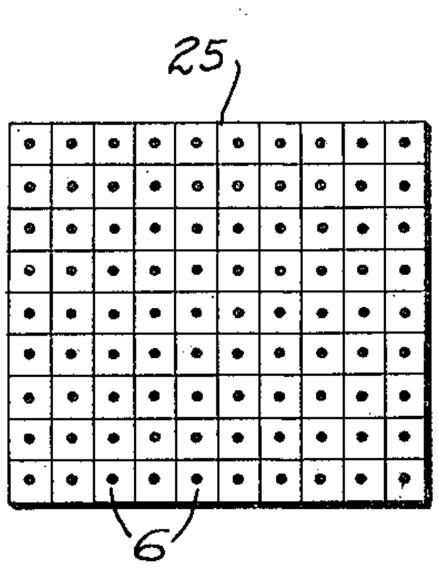


FIG. 4

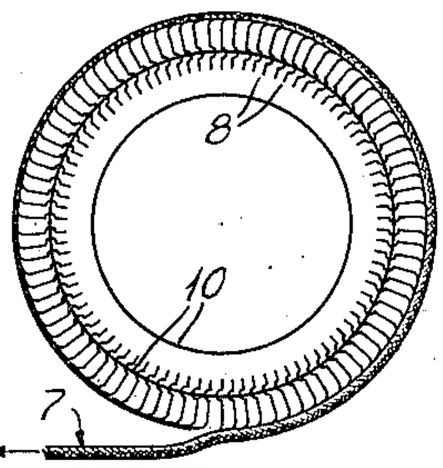


FIG. 5

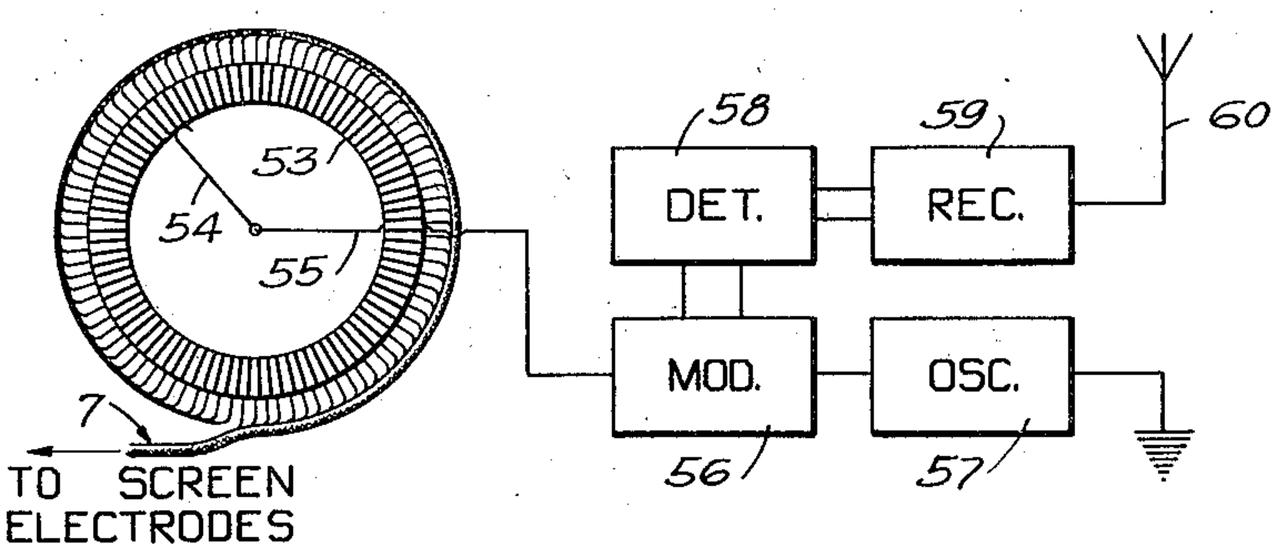


FIG. 6

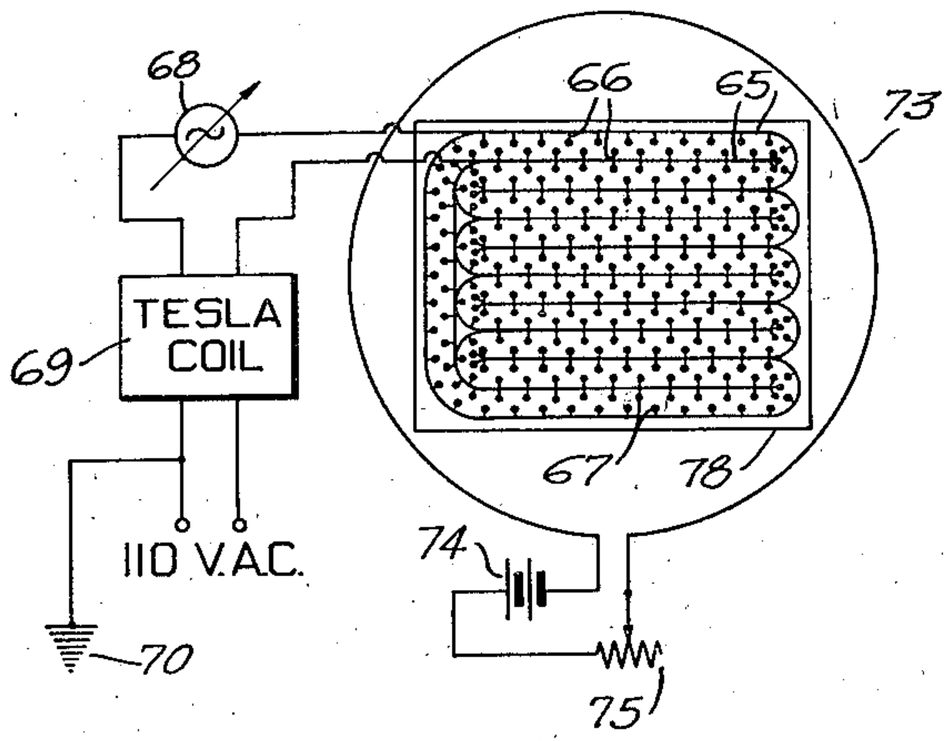
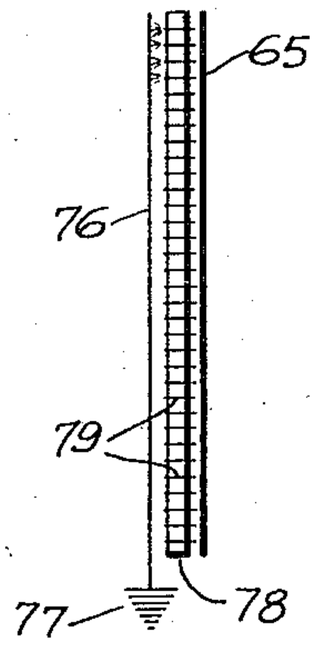


FIG. 7



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Patented Aug. 20, 1935 2,011,947

UNITED STATES PATENT OFFICE

2,011,947

TELEVISION SYSTEM

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Application September 28, 1933, Serial No. 691,319

3 Claims. (Cl. 178—6)

This invention relates to the transmission of intelligence in the form of electrical currents characterized by the light and dark intensities of unit areas of an object or the image thereof, and particularly to the analyzation and production of images in fine-grained detail at a rate to produce the illusion of motion.

In the present systems of this art known as television, resolution or scanning is accomplished by various methods, such as by rotating discs having apertures, lenses or reflectors which produce a moving spot or beam of light intermediate a modulated light source and the screen or observer to reproduce the image; by cathode ray systems wherein the cathode beam is modulated with the image currents and made to impinge upon fluorescent material to produce the variations of the cathode ray in corresponding light values; and by many modifications thereof. Although these types have been under development for a considerable period they all have the disadvantage of producing too large a unit area. That is, the grain of the picture is coarse, so that much of the detail of the object is lost, while images of multiple objects are entirely missing in such systems.

The present invention accomplishes the reproduction of television images in a manner to reproduce the image in all its detail by resolving the object into smaller unit areas and reproducing each of them in its proper size and light intensity relationship. In general, this is accomplished by the use of minute electrodes on the order of pin points or small balls comparable in size to that of newspaper print, commonly called half tone. That is, the unit areas will be individually reproduced at fixed points in actual position and size, thus preventing enlargement and overlapping by variation in scanning apparatus and light diffusion.

An object of the invention is to transmit television images of greater fidelity and accuracy.

Another object of the invention is to analyze an object and reproduce the image thereof in detail comparable to photographs.

Another object of the invention is to use light in the form of a discharge on a sufficiently small scale to approximate an actual photograph of the object being transmitted.

The invention will be more fully understood from the following description read in conjunction with the accompanying drawings in which:

Fig. 1 diagrammatically illustrates a transmitter embodying the invention;

Fig. 2 is a similar drawing of the conjugate receiver;

Figs. 3 and 4 are details of the transmitter and receiver scanning systems;

Fig. 5 shows a substitute arrangement for the scanning system of Figs. 1, 2, 3 and 4;

Fig. 6 is a plan view of a scanning or receiving screen in another form; and

Fig. 7 is a detail of the scanning screen of Fig. 6.

Referring to Figs. 1 and 2, in which the same numerals represent identical elements, a scanning and reproducing screen 5 is composed of a multiplicity of points or small ball electrodes 6 connected through a corresponding number of conductors 7 to probes 8 positioned intermediate continuous electrode rails 10, which are located in a magnetic field produced by winding 11 shown in cross-section, the winding 11 having a core 12. In Fig. 4 the electrode rails 10 with the conductors 7 leading from the probes 8 are illustrated in detail to show the respective positioning of the probes which are placed at uniform intervals between the electrodes. Energy, supplied from a source 15 shunted by a condenser 16 under control of a rheostat 17, produces an electrical discharge between the rails 10, which is driven and propagated there along by the field produced by the coil 11. The coil 11 is supplied from a source 20 under control of a rheostat 21. Such an electrodynamic arc system is the basis of several television systems, some of which are disclosed in my United States Patents No. 1,839,696, January 5, 1932 and No. 1,863,278, June 14, 1932.

Positioned immediately in front of the electrodes 6 is a screen 25 grounded at 26 which may be in the form of a mesh, such as illustrated in Fig. 3, or may be of sputtered metal on a glass screen or a flat glass envelope of translucent electrolytic solution. In other words, this screen is such as to aid in the production of the discharge from electrodes 6, the voltage from which is produced by a Tesla coil 28 connected to the arc rail system and supplied from any proper source of energy, such as a 110 volt alternating current supply. This source is grounded at 29, thus completing the circuit through electrodes 6. It is to be understood, of course, that the system may be operated without screen 25 if the voltage of the Tesla coil is raised to a sufficiently high value. However, it is desirable to use as low a voltage as possible for apparatus of this type and the screen 25 aids in the corona discharge from the electrodes 6.

In Fig. 1, which is the transmitter, an aperture 30 in an opaque screen 31 defines the scanning beam which may be aided by a lens 32 to scan an object O shown in the form of an arrow. The reflected light from the object O modulated by the light and dark intensities of the unit areas thereof, impinges upon a photoelectric device 35. The output of the device 35 is amplified in an amplifier 36, which feeds a modulator 37 and the primary of a transformer 38, which has its secondary in the supply circuit to the electrode rails 10. The purpose of this feed-back or regenerative arrangement provides a synchronizing system between the transmitter and receiver. The impulses produced by the device 35 will react on the moving electrical discharge travelling along the electrode rails 10 by giving to the arc discharge a speed varying in accordance with the output currents of the device 35. That is, the arc will be controlled along the rails 10 by the voltage impulses being received in their supply circuit and they occur at the instants the arc passes the probes 8. It will be thus seen that as the arc reaches a probe thereby connecting the electrodes 6 to the Tesla coil 28 to produce a light spot, an impulse will be provided from the amplifier 36. As the force on the arc is proportional to the strength of the field, the length of the arc and the current therein, an increase in arc current will increase this force. The arc, therefore, will fall into a certain speed relationship with respect to the amplitude of the impulses caused by its commutation.

The output of amplifier 36, after being modulated in the modulator 37, which is supplied with carrier current from an oscillator 40, is impressed upon a transmitter 41 connected to an antenna 42 or a carrier wire system.

Referring now particularly to Fig. 2, the incoming impulses are received upon an antenna 45, amplified in amplifier 46, detected in a demodulator 47, amplified again in an amplifier 48, and impressed upon the supply circuit for the electrodes 10 through a transformer 49. There is thus produced a variation in the intensity of the discharge between the electrodes 6 and the screen 25, if used, proportional to the voltage impressed on the arc discharge electrodes through the transformer 49. This is accomplished by a diminution in the resistance of the arc path to permit a proportional amount of energy to flow to the electrodes 6. As the incoming currents are in the form of impulses proportional to those fed back to the transmitter arc, they will have the effect of keeping the receiver arc at the same speed as the transmitter arc if the other arc control elements have values approximately the same or proportional.

Referring now to the electrode screen 5, which is an important feature of the invention, this screen comprises a plate of insulating material through which are positioned the fine point or ball electrodes 6 closely spaced, comparable to the arrangement of the points on a half tone plate. It is thus obvious that a picture having the same detail as a newspaper print, or better, may be reproduced with this type of television scanning and reproducing screen. With the commutating system just disclosed an extremely large number of points may be commutated at the proper speed. Sufficient arc speeds have been found from development work on television systems in which the light of the arc is employed for the reproduction of the image or for scanning. The plate with its electrodes may be either exposed to the open air or enclosed in an envelope below or above atmospheric pressure. Various gases may be employed in the envelope in accordance with my teaching in the above mentioned patents.

For screens having fewer points, other commutating systems may be used, one type being shown in Fig. 5 which is simply a commutating ring 53 with alternate insulating and conducting segments over which a brush 54 passes. The brush 54 may be driven in any manner such as with a synchronous motor of any well known type. Each conducting segment is connected with a conductor 7, which feeds one of the electrodes 6 of the screen. A common return 55 is connected to a modulator 56, fed from a grounded oscillator 57 which completes the screen circuit. A detector 58 getting its signals from a receiver 59 connected to an antenna 60 completes the receiver circuit. The commutator of this figure may be substituted for the portion of the system of Fig. 2 shown within the dotted lines.

Referring now to Figs. 6 and 7, in which another embodiment of the invention is illustrated, a system of electrode rails 65 have at uniform intervals projections 66 which may terminate in small rounded portions 67. The electrodes 65 are in the form of a continuous path and are connected to a source of alternating potential 68 in which a Tesla coil 69 is included. The coil 69 is supplied as shown from a 110 volt alternating current source grounded at 70. Surrounding the arc screen is a field coil 73 supplied from a source 74 under control of a rheostat 75. The field is illustrated as a single turn but may comprise a solenoid of the type disclosed in the above-mentioned patents or as shown in the other figures, suitably arranged for this type of arc path. This portion of the screen may be enclosed in a transparent envelope as described for the electrodes 6.

Positioned immediately in front of the arc path is a plate 78, which may be of glass with sputtered metal or of insulating material having piercing electrodes 79 positioned therein to form unit areas. Immediately in front of the plate 78 may be positioned a plate 76 grounded at 77 similar to the screen 25 of Fig. 3 to aid in the production of the corona discharge at the terminals of the electrodes 79. It is understood, of course, that the screen 76 may be omitted if the voltage of the Tesla coil 69 is sufficiently high to produce the desired corona effect.

This system operates similarly to the systems of Figs. 1 and 2, except for the method of arc propagation. In the present system the arc is created between two of the points 67 at or near the peak of the wave and is subsequently extinguished at a lower voltage value as the voltage decreases, since the voltage of the Tesla coil is made insufficient to maintain the arc below this voltage. At the next peak the arc is again created between one of the old points and the next succeeding point. The arc strikes here because of the flow of the uncombined ions between the point of extinction and the next point of initiation by the field produced by the winding 73. The winding 73, therefore, is not a driving field winding, as is shown in the commutating systems of Figs. 1 and 2, but is only a biasing winding, that is, it is only required to move the ions a short distance between the arcs. Of course, the field also acts upon the glowing arc which aids its propagation along the electrode rails 65. It is obvious, therefore, that the propagation of the arc along this type of rail system

is intermittent and is controlled by the frequency of the source 68, which may be varied at will. The synchronizing in this system is accomplished by maintaining the frequencies of the driving sources at the transmitter and receiver constant.

What is claimed is:

1. In a television system, the combination of a plurality of electrodes arranged coordinately in an insulating medium, a source of energy for providing an electrical discharge at the points of said electrodes, a set of electrode rails, means for forming an arc between said rails, means for propagating said arc, and means for connecting said electrodes and said energy source through said arc path in a serial order.

2. In a television system comprising a plurality of point electrodes positioned to form an illuminating screen of fine definition, a source of energy for said electrodes, an electrical discharge system including polarized electrodes located in a magnetic field interconnecting said first mentioned electrodes and said energy supply for connecting said energy supply to said first-mentioned electrodes in a serial order, means for translating reflected light from said first-mentioned electrodes characterized by light and dark densities of an object into electric currents, and means for impressing a portion of said currents on said arc electrodes for obtaining a predetermined speed thereof.

3. In a television system, the combination of a plurality of electrodes arranged in a unit area pattern, a source of energy for polarizing said electrodes, a screen located adjacent said electrodes, said screen having continuous electrode rails, means for creating an arc on said electrode rails, means for creating and propagating an arc along said rails, said plurality of electrodes being arranged along the path of said arc rails for imparting to said plurality of electrodes in serial order a portion of the energy of said arc to create a discharge at the terminals of said plurality of electrodes in accordance with the strength of said arc.

ALEXANDER McLEAN NICOLSON.