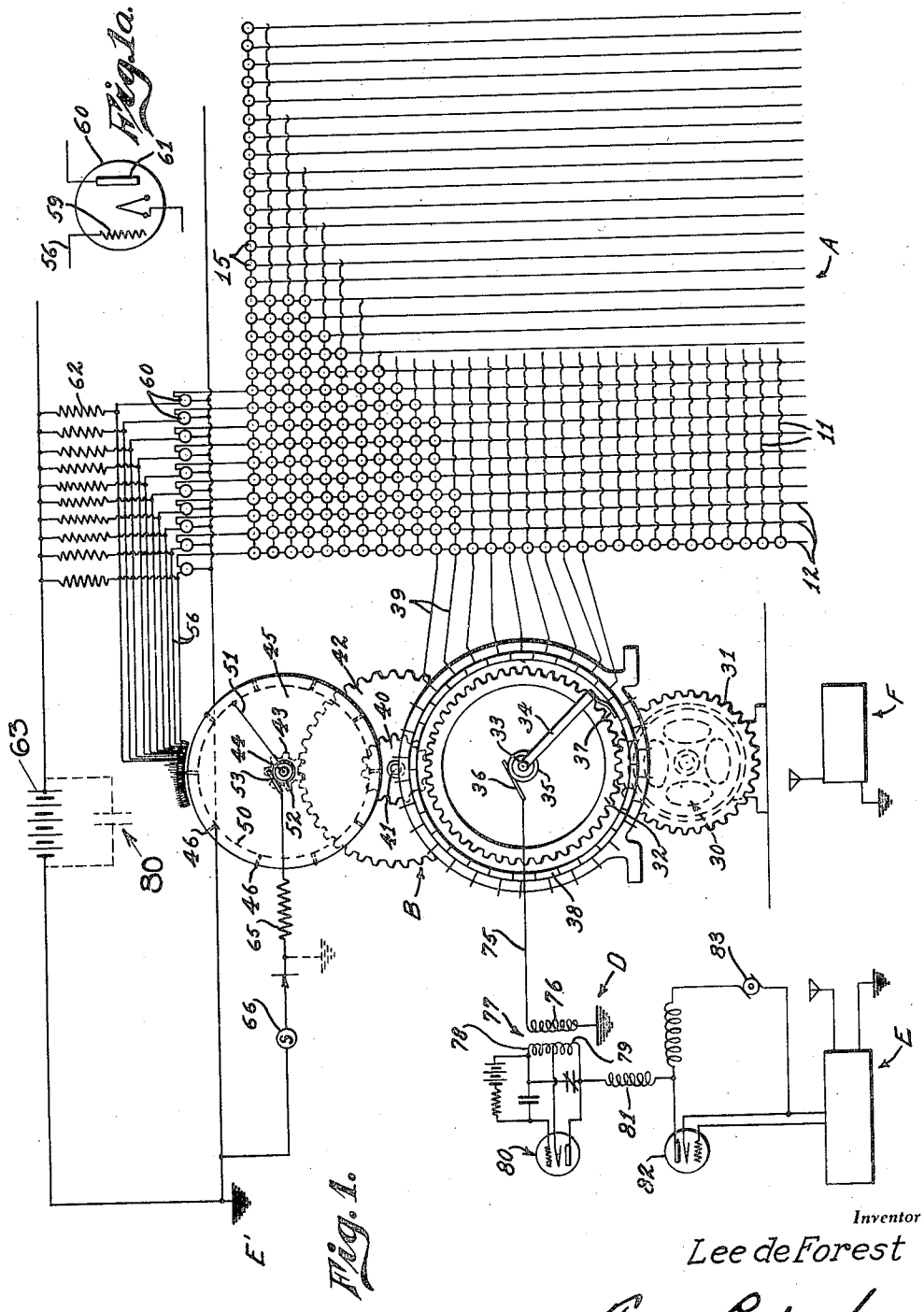
Aug. 4, 1936. L. DE FOREST 2,049,763

TELEVISION SIGN

Filed Aug. 10, 1931 2 Sheets-Sheet 1



Inventor

Lee de Forest

By Fraser Cushman

Attorney

Aug. 4, 1936. L. DE FOREST 2,049,763

TELEVISION SIGN

Filed Aug. 10, 1931 2 Sheets-Sheet 2

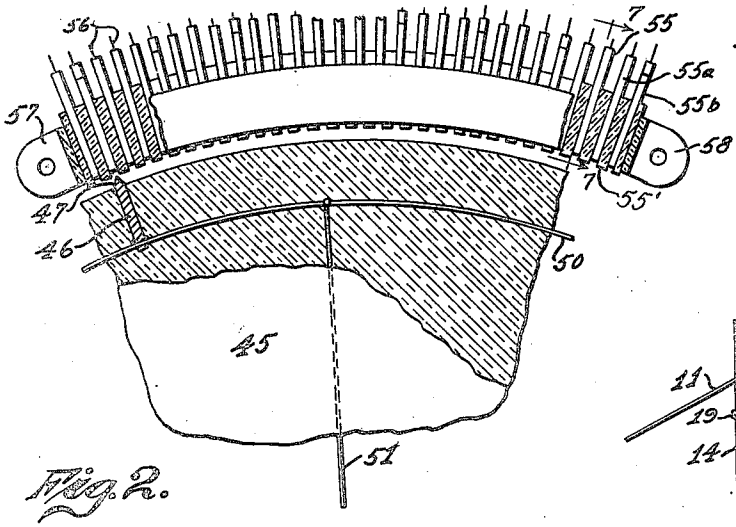


Fig. 2.

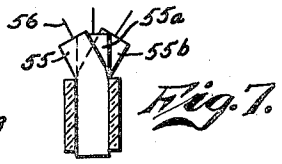


Fig. 7.

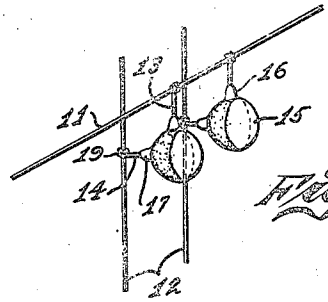


Fig. 3.

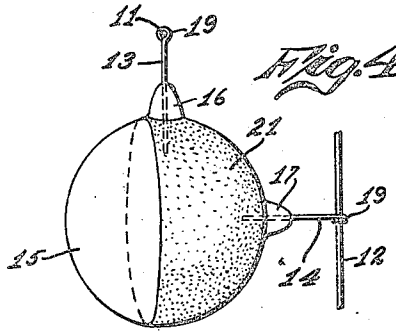


Fig. 4.

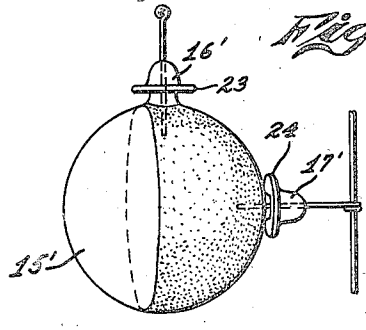


Fig. 6.

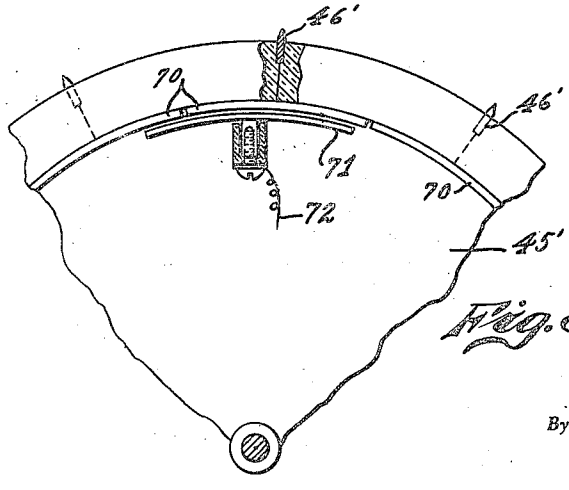


Fig. 8.

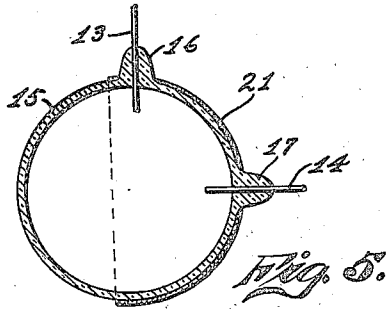


Fig. 5.

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2,049,763

TELEVISION SIGN

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Application August 10, 1931, Serial No. 556,128

7 Claims. (Cl. 178—6)

This invention has to do in a general way with the utilization of televised electrical impulses to reproduce television images, and is more particularly related to improved systems for television reception purposes which contemplates the production of an electrically illuminated outdoor display or sign, the displayed feature or image thereon comprising a reproduced televised image.

It is a noteworthy feature of this invention that the electrical impulses utilized in forming the image or display on the sign may be in the form of either electric current impulses conducted through suitable conducting means from the transmitter or may be in the form of radio impulses released from a radio television transmitter.

The sign contemplated by this invention has the distinct advantage over the usual large electrical sign in that signs of the latter type are limited as to the material which may be displayed thereon, whereas with a sign of the type contemplated by this invention there is no limitation as to the images which may be released from the sign.

The sign contemplated by this invention has a further advantage in that whereas most electrical displays are of the silhouette or varicolored type, this display may be used to reproduce an unlimited number of pictures or images of either the silhouette or so-called halftone type.

Another obvious advantage of the device contemplated by this invention resides in the fact that a plurality of illuminated screens or sign panels may be associated with a single transmitter to simultaneously release the same image or advertising matter. In this manner a number of these signs may be distributed throughout a large community, and advertising time may be sold for all these signs; the advertising material for the different advertisers being released from time to time over a complete set of signs from a single television transmitter.

It is well known to those familiar with the art that a television transmitter consists in a general way of a scanning disk associated with a photoelectric cell. The usual type of scanning disk, known as the "Nipkow" type, consists of a metal disk associated with suitable driving means, the disk being provided near its periphery with a series of spaced apertures arranged in a spiral so that during the rotation of the disk the apparatus "scan" a region, the area of which corresponds to a rectangle, which is equal in length to the distance between the apparatus, and in height to the distance from the uppermost to the lowermost aperture in the spiral.

The object to be televised may be illuminated by light projected through the apertures of the rapidly revolving scanning disk, and such light transcribes successive lines across the object; part of this light being reflected to a photoelectric cell, which is used to modulate the current leaving the television transmitter. This current may, as pointed out above, leave the transmitter as radio impulses or may be carried from the transmitter by a suitable conductor.

In the usual practice, the transmitted energy is received and the image reproduced by apparatus which is essentially similar to the transmitting apparatus in that it embodies a scanning disk similar to and operated in synchronism with the scanning disk and is associated with a glow lamp, the illumination of which is controlled by the amplified impulses coming from the television transmitter.

As pointed out above, the device contemplated by this invention has to do with improvements in the apparatus for receiving and reproducing televised images, and differs quite radically from the common form of receiving apparatus described above in that the image is reproduced upon an illuminated screen or bank of glow tubes which are arranged in rows corresponding in number to the number of lines traced across the object by the scanning disk at the transmitter. These glow tubes are operatively associated with commutator means and a television receiving circuit in a manner such that each successive glow tube in each successive row is illuminated momentarily by amplified high frequency electrical energy, such energy being modulated by the received television signal. In other words, while one aperture passes through the area defining the televised image, the successive lights or glow tubes in that row of glow tubes in the sign corresponding to the position of the particular aperture in question are illuminated in succession as the aperture passes over the scanned area. Since the energy carried to the various glow tubes is modulated by the received television signal, it will be apparent that the intensity of illumination in the particular glow tubes varies directly with the intensity of the reflected light at the transmitter station, so that the ultimate result is a reproduction of the image with the various lights and shadows or halftone qualities that appear in the televised object.

The details in the construction and operation

of a preferred form of my invention, together with other objects attending its production, will be best understood from the following description of the accompanying drawings in which are chosen for illustrative purposes only and in which—

Fig. 1 is a diagrammatic view illustrating in a general way the construction of the apparatus, and one form of circuit which may be employed in its operation;

Fig. 1ª is an enlarged diagrammatic view illustrating one of the tubes used in connection with the bank of glow tubes in Fig. 1;

Fig. 2 is a fragmentary view partly in section illustrating the details in the construction of a preferred form of commutator unit contemplated by this invention;

Fig. 3 is a perspective view illustrating a preferred arrangement of glow lamps and their associated conductors used in constructing the illuminated screen;

Fig. 4 is a perspective view illustrating the construction of one form of glow lamp;

Fig. 5 is a sectional view showing details in the construction of the glow lamp illustrated in Fig. 4;

Fig. 6 is a perspective view showing another form of glow lamp;

Fig. 7 is a sectional view showing the arrangement of stationary segments employed in the commutator shown in Fig. 2 and may be considered as having been taken on the plane represented by the line 7—7 in Fig. 2; and—

Fig. 8 is a fragmentary view with parts broken away, illustrating details in the construction of a modified form of commutator.

More particularly describing the invention as herein illustrated, I show in Fig. 1 an illuminated sign or one corner of an illuminated sign indicated generally by reference letter A. This sign is associated through suitable electrical connections which will be hereinafter more fully described with commutator means or a commutator unit B, such unit being adapted through electrical conductors to receive high frequency electrical energy from a source D, such energy being modulated by television signals received in the receiving and amplifying set indicated at E.

The signals received in the receiving set may come from a radio television transmitter F, or, as pointed out in the fore part of the specification, it may come from a television transmitter which is directly connected through suitable conductors with the receiving set.

Referring now to the illuminated sign A, I prefer to construct this sign by utilizing two grids, each consisting of a series of parallel conducting wires suitably supported and insulated in vertical planes; one of the grids consisting of wires 11 which run horizontally, is spaced behind the other grid consisting of vertical wires 12. The two grids therefore comprise a plurality of wires, the wires in each grid being contained in a vertical plane and arranged so that they are angularly disposed relative to the wires in the other grid. The space between the two grids is preferably from 6 to 12 inches. This arrangement is perhaps best illustrated in Fig. 3 where the wire 11 and the wires 12 are shown as being connected in the region where the wire 11 crosses in front of wires 12 with terminal connections 13 and 14 of glow lamps 15. These glow tubes may be of any convenient form, but I prefer in the interests of economy and efficiency to construct them in globular form with the two electrodes leading into the vessel at right angles to each other, as shown in Fig. 5.

The globular or spherical vessels are gas-filled, preferably with one or a mixture of the noble gases, such as neon, argon, etc., or mercury vapor or a suitable mixture of two or more of such gases or vapors properly exhausted.

For a sign of the type contemplated by this invention, the spherical vessels constituting the glow tubes have a diameter of from 4 to 6 inches, although for a smaller sign these tubes may be of much smaller diameter, and the electrodes 13 and 14 are led into the vessels through elongations 16 and 17 provided at right angles to each other. The electrodes, which may be made of any suitable material, such as copper, nicrome, or carbon, are sealed into the glass at these elongations or extension points, and their outer ends are fastened by means of welding or the like to a suitable wire for making an air-tight seal through the glass. For example, the electrodes 13 and 14 may be formed of copper welded to a tungsten wire, the latter metal being tightly sealed to the glass, or the tungsten may be continued into the bulb and serve as the electrode itself.

At the extreme outer end of the electrodes 13 and 14 I attach a suitable length of soft copper wire, indicated at 19, which may be readily bent around and soldered or clamped to the corresponding horizontal or vertical wire 11 or 12 of the supporting grids.

For the purpose of increasing the radiation of light from the illuminated gases within the glow tubes, I prefer to silver the rear half of the vessels on the exterior of the glass as indicated at 21, and to protect this material from the weather with a coating of suitable weather-proof paint or varnish.

Since the sign contemplated by this invention is designed primarily for out-of-doors use, I consider it preferable in order to prevent current leakage over the surface of the glass to remove the silver deposit from the projections 16 and 17, and in order to further insure against such leakage I show in Fig. 6 a modified form of glow tube 15' in which the lower end portions of the extensions 16' and 17' are provided with skirts 23 and 24.

As was pointed out in the earlier part of the specification, the sign contemplated by this invention is operated by illuminating each successive glow tube in each successive row, the period of illumination being controlled so that each row of glow tubes has been illuminated during the period over which a corresponding aperture in the scanning disk at the transmitter passes through the field of view.

In this particular form of my invention, the glow tubes are illuminated in horizontal rows. In other words, the operation starts by each successive glow tube in the top row being momentarily lighted, then the second row from the top, and so on until each of the glow tubes in each of the rows has been lighted after which the same cycle is repeated. In actual operation this procedure must be carried out many times a second, for example, where the disk at the transmitter is rotated at a speed of ten revolutions per second, it is necessary that each successive glow tube of the entire sign be lighted ten times each second.

In the preferred form of screen contemplated by this invention, I propose to use 100 rows of glow tubes, each row containing 100 tubes. In

other words, the complete sign consists of a bank of 10,000 glow tubes, each of which must be illuminated ten times per second. For the purpose of illuminating only one of the glow tubes at a time, I apply a high tension current to each successive horizontal wire 11, and during the period over which current is being supplied to each horizontal wire I deliver current to all the vertical wires; this delivery of current to the various wires of the illuminated screen is of course accomplished through the medium of the commutator unit B.

In the form of my invention illustrated herein, the voltage is applied to each horizontal wire for a period of one-thousandth of a second. At the end of this period the brush of the proper commutator moves to the next segment connecting the next following horizontal wire of the grid where it remains for the next succeeding one-thousandth part of a second and so on down the grid until each of the 100 horizontal wires of the grid has been connected to the feeding brush for one-thousandth of a second. The total time thus elapsed comprises one-tenth of a second, after which the cycle is repeated. This means that the high potential current is applied to the horizontal wire ten times in a second, and for the period of one one-thousandth of a second during which interval, making a total time of one one-hundredth of a second during which each horizontal wire is thus charged. Similarly, each of the vertical members of the other grid which, for purpose of illustration, is described as comprising 100 wires, is excited by means of a special high speed commutator system which will be hereinafter more fully described, such excitation being for a period of one one-hundred-thousandth of a second in sequence; that is to say, the commutator supplying the potential to the 100 vertical wires effectively sweeps over the terminals of the wires in one-thousandth of a second, during which interval one of the horizontal wires has remained connected to the terminal of the high voltage source of supply.

By the arrangement just described, it will be seen that each of the 10,000 spherical glow tubes connecting the so-called crossing points of the horizontal and vertical grid wires is connected into the circuit ten times a second and that each glow tube will be illuminated and extinguished at the rate of ten times a second, the total period of illumination at each interval being somewhat less than one one-hundred-thousandth of a second, due to the fact that a certain time interval is necessary for the commutator brush to shift from segment to segment

The degree of illumination of each glow tube will of course vary from instant to instant, depending upon the voltage which may be applied to the cross terminals at any given instant. Under certain conditions it may be that the voltage applied to each tube is either zero or a certain maximum with no intermediate voltage graduations, under which circumstances the picture reproduced on the screen, made up in this instance of 10,000 glow tubes, will be what is known in the television art as a silhouette picture consisting of an equally illuminated figure against a uniformly black background.

When varying degrees of voltage are applied to the vertical and horizontal grid wires, such voltage being attendant with so-called half-tone modulations with the received television signal, the figure reproduced will also be a half-tone picture of graduated degrees of illumination corresponding to the lights and shadows on the object at the transmitting station.

Referring now to the commutator means B, whereby the electrical potential is applied to the various elements of the grid members, reference numeral 30 indicates a motor which is adapted to operate in synchronism with the corresponding motor at the transmitting station, and which is provided with a gear 31 meshing with a gear 32, which is mounted on a shaft 33. The shaft 33 carries a brush 34 which is attached to a slip ring 35, the slip ring being engaged by a brush 36. The indicating element 37 of the brush arm 34 engages a stationary commutator ring 38, the various segments of which are connected through conductors 39 with the horizontal wires 11 of one of the grid members. Reference numeral 40 indicates a pinion which is mounted on the shaft 41 carrying a gear 42 which in turn drives a pinion 43 mounted on a shaft 44 upon which is mounted a commutator disk 45.

It will be observed from the description of the operation of the screen that the commutator arm 34 must be rotated ten times a second or 600 R. P. M., and that during this time the commutator element which supplies current to the vertical grid wires must revolve one hundred times as fast, or at the rate of 60,000 R. P. M. This speed is of course impractical and in this form of my invention I accomplish the desired ultra-rapid commutation by the simple expedient of applying ten instead of one rotating brushes, or their equivalent, to the shaft 44. In this manner the shaft 44 needs to rotate at a speed of only 6,000 R. P. M., which, for the small mass and diameter involved, is a practical speed. The construction of the high speed commutator is therefore accomplished by providing the disk 45 with ten angularly spaced brush points 46 which are connected together and which project a slight distance from the disk, as indicated at 47 in Fig. 2. As shown in this figure, the 100 segments of the commutator, instead of being distributed evenly around the entire circumference of the rotating brush, are compacted into an arc of substantially 36°, and as pointed out above, instead of employing only one rotating brush I employ ten, which may either be mounted at the ends of radial arms or, as shown, are preferably projecting from the periphery of the rotatable disk 45.

The disk 45 may be made of metal or insulating material, but in any case is preferably insulated from the shaft 44, the individual brushes 46 being connected as shown in Fig. 2 through conductors 50 and 51 with a slip ring 52 and a brush 53. The 100 commutator segments in this case consist each of a very thin plate of metal 55, 55a, and 55b. These plates may, in the form of my invention described herein, be of the order of .001 to .005 of an inch in thickness, and between each two of these metal strips I place a thin sheet of mica 55', or other suitable dielectric, which is preferably substantially .030 inch in thickness. The mica plates or spacers widely overlap the commutator laminations at all margins and the laminations 55, 55a, and 55b are preferably so formed that their upper ends project alternately at oblique angles to each other, first to the left, then vertically, and then to the right, as shown in Fig. 7. To these separated extending ends of the laminations are soldered the conductors 56 which are used to connect the segments to the respective vertical grid wires. By such an arrangement, the mutual capacity between the laminations and their connections is effectively

reduced. This entire assembly of thin laminations and thicker separators, or spacers, is tightly compressed between two clamping plates 57 and 58 in such a manner and shape that the lower edges of the laminations of the commutator are thus assembled to conform exactly to the arc of a circle described from the center of the shaft 44. The projecting edges of the mica spacers are accurately milled off, conforming to the circular path traveled by the brush points 47, and at such a distance therefrom that the edges of the brushes sweep by the spacers just out of contact therewith. The edges of the commutator segments or laminations lie within a few hundredths of an inch from the exposed edge of the brush so that the electrical discharge from the brush will pass only to the commutator lamination which is directly in front of that particular brush at any given instant, and as the brush moves on, the mica lamination serves to wipe out the electrical discharge which then passes on in front of the next succeeding cavity to deliver a charge to the next succeeding lamination recessed between the spacers.

By the above described arrangement, which will hereinafter be referred to as an arcuate stator, in combination with the rotor 45, I have succeeded in producing a contactless commutator which is exceedingly compact and whereby an electric discharge may be applied to each of the 100 commutator segments in sequence at a time interval of substantially one one-hundred-thousandth of a second.

In the arrangement just described, if each spacer is .030'' in thickness, and each metal lamination is .005'' thick, the total length of the commutator of 100 segments is only 3.5'', which requires a disk of approximately 35'' in circumference, or substantially 10'' in diameter. A disk of this diameter rotated at 6,000 revolutions per minute offers no special mechanical difficulties. It is clear therefore that by this arrangement I can successfully commutate large amounts of electrical energy 100,000 times per second without the slightest wear upon the commutator or the brushes.

Each of the conductors 56 leading from the commutator segments is connected to the grid 59 of a three-electrode tube 60, the plate 61 of which is connected to a corresponding vertical grid wire 12. These tubes (one for each grid wire) may be of the high vacuum type, or they may be of the mercury vapor or the "Thyratron" type, shown in Fig. 1a. Each of the conductors 56 leading to the grids of these tubes is connected through a suitable high resistance 62 to a common negative terminal of a battery 63 of suitable voltage or some equivalent source of electromotive force. The positive terminal of this source is grounded to the earth, as indicated at E'. Under these circumstances it will be seen that the grid of each triode is normally negatively charged from the common source 63. The rapidly rotating brushes 46 on the disk 45 are adapted to be connected successively through the brush or wiping contact 53 and a suitable resistance 65 to the positive terminal of another source of electromotive force. This latter source of voltage may be a radio frequency source, or, preferably, a constant voltage supply either from a battery or a rectified alternating current source indicated at 66. The rectified alternating current may be the conventional form of a rectifier associated with the reservoir condenser, the positive terminal of which is connected to the brush 53 and the negative terminal may be grounded as indicated at E'.

It will be apparent that if the voltage of the source 66 is sufficiently high, it is unnecessary that the brush points 47 actually contact with the various segments 55, etc., of the commutator. High voltage discharge of negligible current energy will pass from the successive brush points 47 which are preferably made of needle or wedge-like sharpness into that segment of the commutator to which it is opposed at any given instant. The current energy represented by each successive discharge into any given commutator lamination is so minute as to work no wear or damage whatsoever either to the brush points or the commutator segments yet the positive charge which passes from the respective brushes to the respective laminations is sufficient to instantly and temporarily neutralize the negative charge which has been built up on the grid of its respective triode and thereby permits the instantaneous passage of what may be a very large amount of electrical energy between the anode and the cathode of the three-element tube or triode. It is not always necessary that even the minute electrical discharge shall pass from the brush point to the commutator laminations as a certain amount of electrostatic positive charge may be induced upon the lamination sufficient to neutralize the negative charge upcn the grid of the triode, which is all that is necessary in order to permit the passage of the required electrical energy between the other two electrodes of the tube. In fact, it may, under certain conditions, be sufficient merely to ground the brush to the earth to permit the negative charge on the grid to discharge to the brush as the latter passes the proper commutator lamination. It is desirable to energize only one brush of the series of ten during the short period of rotation, and this may be accomplished, as shown in Fig. 8, by leading each successive brush 46' to an appropriate sector of a condenser 70, these sectors being mounted by insulators on the disk 45' and adapted to pass in sequence in close proximity to a fixed condenser segment or plate 71. This last mentioned plate is connected through a conductor 72 to a suitable source of positive electromotive force, such as that indicated in 66 in Fig. 1.

Instead of the direct current source 66 illustrated and described above, I may employ an alternating current source, the period of which is in this instance 100,000 cycles per second, it being understood that the period and phase of such current must be rigorously controlled by some means well known in the radio art, which in turn are governed and controlled by mechanism associated with the shaft 44. The control of the period and phase of the current mentioned above must be such that a high voltage positive peak from this high frequency source is applied to the brush just at the instant when the latter is in front of a lamination of the commutator, the negative peak being applied thereto during the time interval when the brush is passing from one lamination to the next. By this arrangement there is no tendency for an arc-over from the brush to the commutator segment which it is leaving.

Reference numeral 80 (Fig. 1) indicates a condenser which may be connected across the terminals of battery 63 for the purpose of building up a charge which will be suddenly released as the brush points 47 pass the segments 55 of the arcuate stator. It is to be understood that in-

stead of one condenser, as shown, I may employ a plurality of such condensers, one interposed between each conductor 56 and the brush.

Referring now to the slow speed commutator which energizes the horizontal grid wires 11, it will be understood that at the relative low speed of 600 R. P. M., at which the arm 34 is revolving, commutation affords no particular difficulties, and I am able to transfer a large amount of electrical energy from the brush to each commutator segment in sequence. Each commutator segment may, for example, be ½" wide and 6" in length, with ⅛" dielectric spacer between the segments. This would, in the apparatus described, give a commutator diameter of approximately 20", and ample contact area to carry, without noticeable sparkling or harmful deterioration of the brushes many hundred amperes of current, since the current thus commutated is not from a direct current source, but from a pulsating high frequency source wherein the voltage passes through zero 100,000 times a second. The brush 37 is, in the illustrative case just cited, preferably no more than ¼" in width, 6" in length, and is suitably laminated in both directions so as to insure perfect and smooth contact to each commutator segment.

While I have illustrated stator commutator segments with their active faces concave, it will be understood that the commutator may be built up in the customary fashion wherein the active surface over which the brush travels is convex.

In order that the brush 37 may leave one commutator segment before any electrical energy is transferred to the next segment, it may be preferable to omit the last two or three or more wires of the vertical grid system, together, of course, with their corresponding triodes, etc. In other words, while the system employs 100 horizontal wires, there may be only 98 or 97 vertical wires and 9800 or 9700 glow tubes. In this manner the slower moving brush will have an opportunity to completely pass the segment for one horizontal wire and may contact with the next segment without lighting any of the glow tubes in the sign, thus avoiding possible duplicate lighting of the tubes at this period and resultant blurring of the television image.

The energy for the horizontal grid wires is delivered to the brush 36 through a conductor 75 which is connected to one terminal of a secondary coil 76 of a high frequency transformer 77. The primary winding 78—79 of the transformer 77 is connected to the plate and grid terminals of a triode oscillator 80. This oscillator system is tuned (in a sign of the type described above) to 100,000 cycles per second. Its plate electrode is connected through a choke coil 81 to the plate of a modulator triode 82. A direct current source 83 supplies both oscillator and modulator plate current, and the grid and cathode of the modulator 82 are connected to the output circuit of the television receiver amplifier E. Inasmuch as the high frequency circuit comprising the secondary coil 92, the slow speed commutator, the horizontal grid wire, the gas-filled glow tube, the vertical grid wire, the triode 60, and the ground connection, always contains a rectifying element (the triode) it is obvious that only the positive pulses of radio frequency energy supplied from the transformer 77—78 can pass therethrough. This means that the current arc passing through the triode is extinguished during each half cycle or in the case under consideration it is extinguished 100,000 times per second. This rapidly repeated suppression of the current passing across the brush and commutator contact permits the brush to pass from one commutator segment to the next without causing a violent arc-over detrimental to brush and commutator. During the idle half cycle while the plate of the triode is negative, the positive charge which has been delivered to the grid of the triode from the high speed commutator, and which thus permits the triode to pass current from the plate to cathode is dissipated, since the negative charge is again built up on the grid from the negative potential source 63 through the grid-leak resistance. This reestablishes the normal high impedance of the triode, and although its plate may continue to be connected through one or more of the glow discharge tubes in series-parallel arrangement with the horizontal conductor which is still connected to the high frequency source 76, it will be apparent that the particular triode in question cannot again rekindle until the next succeeding positive impulse is impressed upon its grid by the next succeeding passage of a brush 46 in front of the commutator segment connected to the particular grid. Consequently each individual glow tube can be illuminated only during one positive half cycle of the high frequency supply current, and must remain extinguished until a commutator brush 46 is again in front of the appropriate lamination segment connected to the grid of the triode which has its plate electrode connected with the glow tube in question.

Moreover, inasmuch as the unlighted glow tubes require a certain high breakdown voltage, it is not possible for the current to pass through a number of these unlighted tubes in series-parallel arrangement, because the series resistance of any arrangement, although there may be 999 of such glow tubes involved, remains at an exceedingly high value. The current, therefore, can only pass through the individual glow tube which is directly connected between the vertical and the horizontal grid wires which are at that instant energized by virtue of the double commutator arrangement which I have described.

In this respect my grid arrangement for a television screen or sign, which comprises ten thousand glow tubes, differs fundamentally from the formerly proposed, but always inoperative similar arrangement, whereby incandescent lamps of low resistance, when cold, are used to make up the sign or television screen. For in such a case, as will readily be recognized, every lamp in the system is more or less energized at all times through a series-parallel circuit arrangement regardless of the particular vertical and horizontal conductors to which the two brushes, which are supplying the electrical energy, may at any instant be applied. Obviously, therefore, such an arrangement with incandescent lamps would consume an enormous amount of current at all times, most of which would afford no useful illumination, but would result in one bright light surrounded by others of progressively lower illumination as their distance from the bright light increased. Such an arrangement using incandescent lamps is therefore utterly impractical for the purpose of a television screen or sign.

It is obvious that in an operative system such as I have described, the positive charge must be applied to the grid of a thyratron during the time when a positive half cycle of the main power supply is applied to the anode of that thyratron.

Inasmuch as the amount of energy which can pass through a thyratron during a positive half

cycle is proportional to the electromotive force during that period, and inasmuch as in the arrangement I have shown this applied electromotive force varies from instant to instant in accordance with the received television signal, it is obvious that the glow tube in circuit at that instant will be more or less illuminated in proportion to the amplitude of the incoming signal at that instant, provided always that the electromotive force applied across the terminals of the glow tube is sufficient to kindle it.

While I have hereindescribed and illustrated one preferred form of my invention, and for the purpose of clarity have described the sign as having a given number of elements, it is to be understood that the number of elements in the sign may be varied to suit the particular circumstances under which the sign is to be operated, and that the invention is not limited to the precise construction as described above but includes within its scope whatever changes fairly come within the spirit of the appended claims.

I claim as my invention:

1. A commutator embodying the combination of an arcaute stator comprising a series of insulated conductor segments; a rotor positioned with its axis at the center of curvature of said arcuate stator; a plurality of angularly spaced brushes mounted on said rotor, the radii of said brushes being less than the radius of curvature of said segments; and laminations between said segments, said laminations extending inwardly beyond said segments and into substantial engagement with said brushes.

2. A commutator embodying the combination of an arcuate rotor, a plurality of angularly spaced brushes mounted on said rotor, a stator positioned with its axis at the center of curvature of said rotor, said stator having a series of insulated conductor segments, the radii of said segments being less than the radius of curvature of said brushes, and said laminations extending outwardly beyond said segments and into substantial engagement with said brushes.

3. A television receiving device comprising a plurality of conductors, a plurality of cross conductors, a plurality of glow tubes connected across said conductors, a plurality of valves having grids and plates, said plates being connected to the respective conductors, a first commutator means for completing a television signalling circuit through successive cross conductors, additional commutator means for completing successive circuits to the grids of said valves to render said signalling circuits conductive, means for causing current fluctuations at the frequency of connection to the glow tubes, and means whereby said first commutator means makes and breaks circuits to said cross conductors at times of substantially zero current in said circuit.

4. A television receiving device comprising a plurality of conductors, a plurality of cross conductors, a plurality of glow tubes connected across said conductors, a plurality of valves having grids and plates, said plates being connected to the respective conductors, a first commutator means for completing a television signalling circuit through successive cross conductors, additional commutator means for completing successive circuits to the grids of said valves to render said signalling circuits conductive and means for causing fluctuations at the frequency of connection to the glow tubes whereby said additional commutator means makes and breaks circuits to said grids with substantially zero current across the commutator contacts.

5. A television device comprising a television receiving circuit, a plurality of glow tubes, commutating means for connecting said glow tubes successively in said receiving circuit, a plurality of valves selectively connected in said circuit, and means for modulating incoming signals with a wave having a frequency equal to the frequency of connection of said glow tubes whereby said commutator may make said connections and break said connections at instants of approximately zero current in said circuit.

6. A television device comprising a television receiving circuit, a plurality of glow tubes, commutating means for connecting said glow tubes successively in said receiving circuit, and means for rendering the positive peaks only of received signals effective to produce current in said receiving circuit whereby signals modulated with a wave having a frequency equal to the frequency of connection of glow tubes may be applied to said glow tubes through said commutating means at instants of approximately zero current.

7. A television device comprising a television receiving circuit, a plurality of glow tubes, a plurality of valves having grids and plates, circuits for each of said grids and plates, means for connecting said glow tubes and said plate circuits successively in said receiving circuit, and commutating means for impressing a wave on successive grids of a frequency equal to the frequency of connection of said glow tubes for releasing current in said receiving circuit.

LEE DE FOREST.