Feb. 18, 1941. W. SOLLER 2,231,961

TELEVISION SYSTEM

Filed Aug. 3, 1938 5 Sheets-Sheet 1

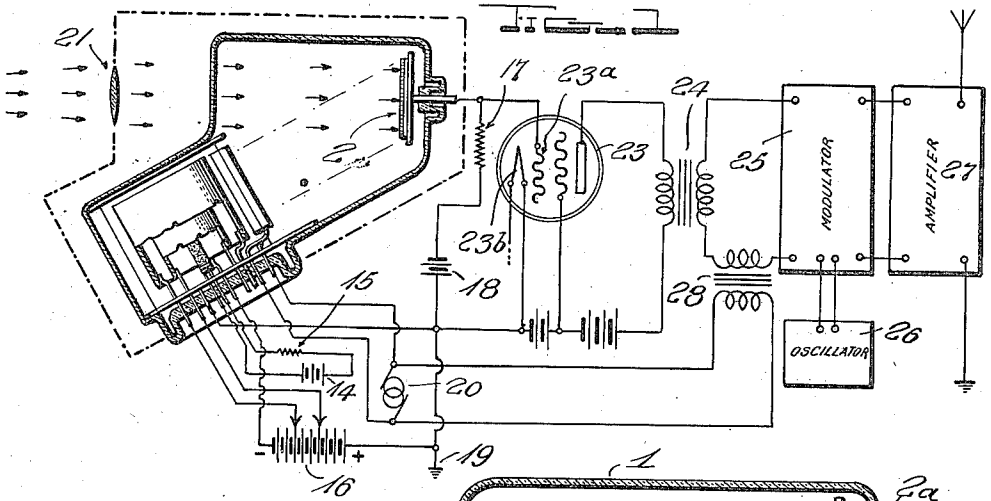


FIG. 1

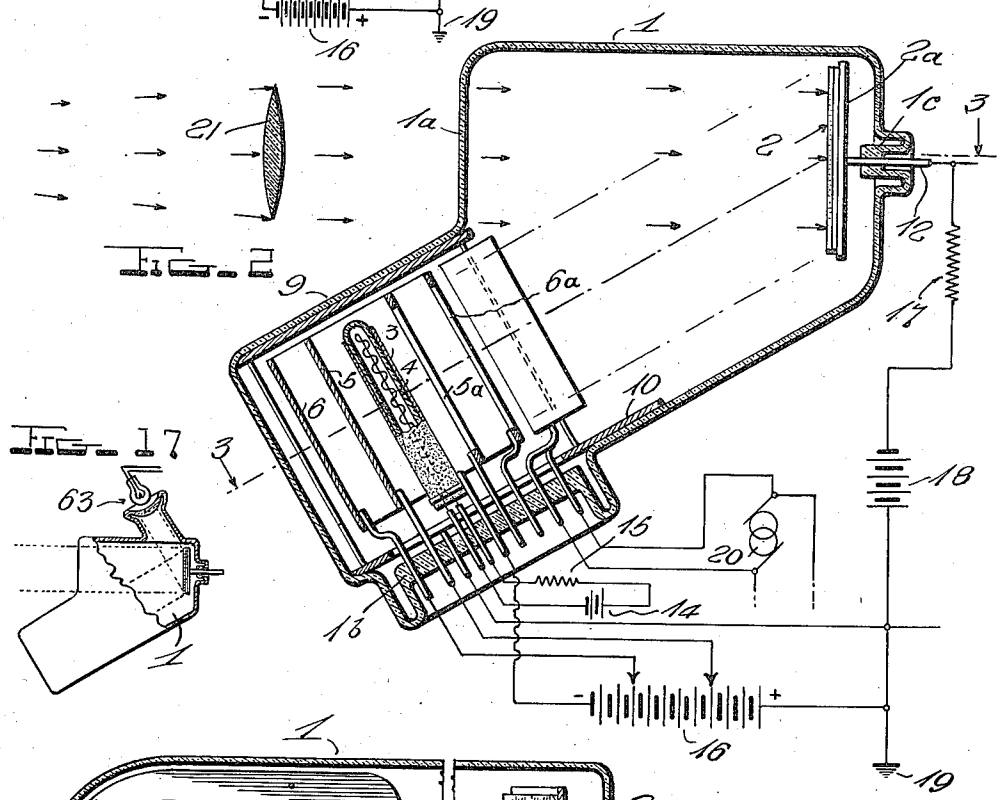


FIG. 2

FIG. 17

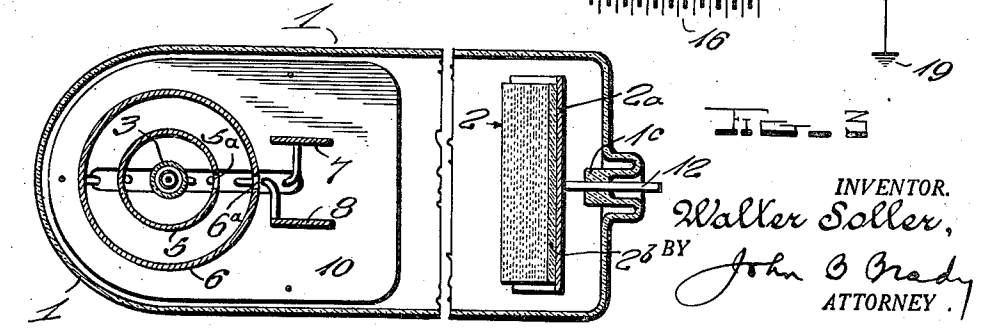


FIG. 3

INVENTOR.
Walter Soller,
BY John B Brady
ATTORNEY.

Feb. 18, 1941. W. SOLLER 2,231,961

TELEVISION SYSTEM

Filed Aug. 3, 1938 5 Sheets-Sheet 2

FIG. 4

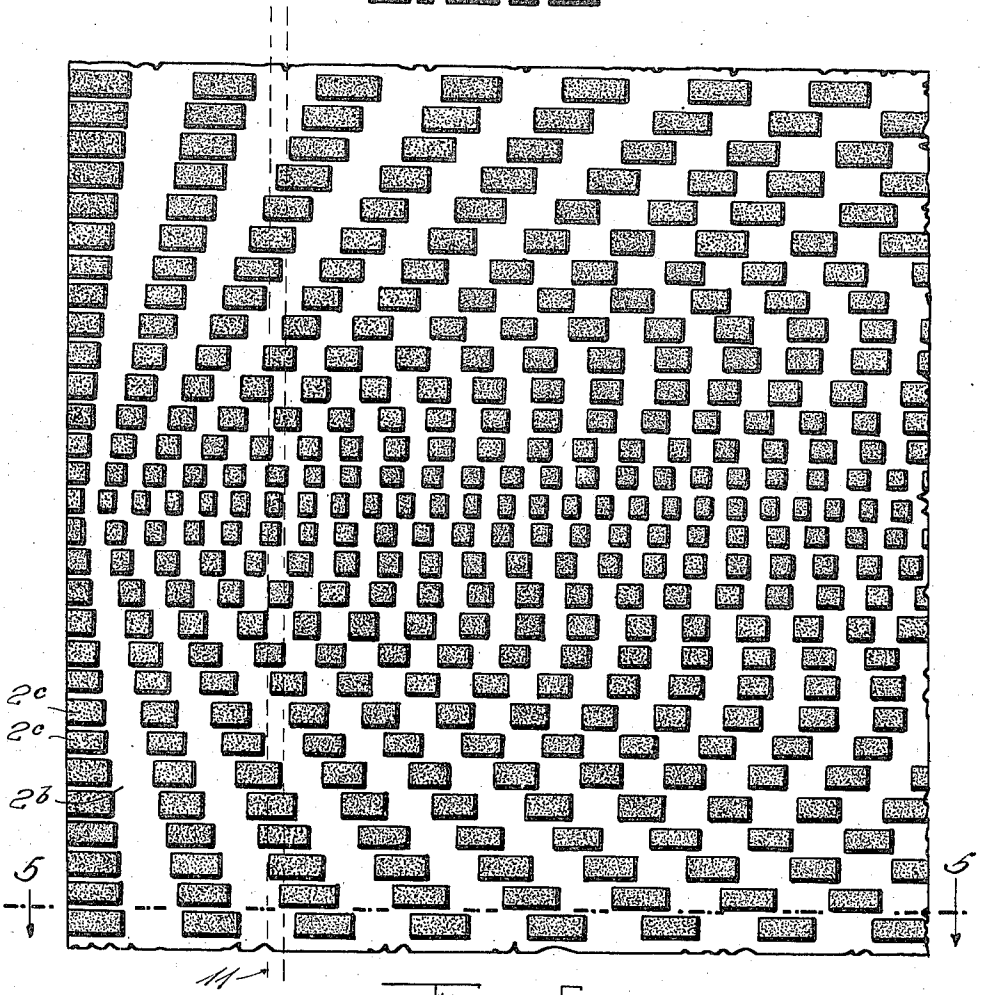


FIG. 5

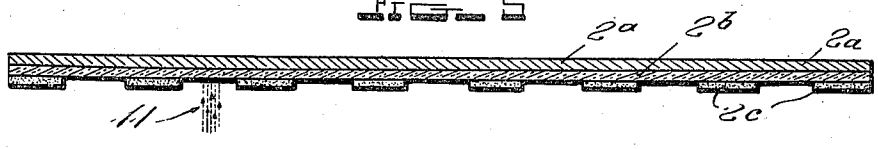
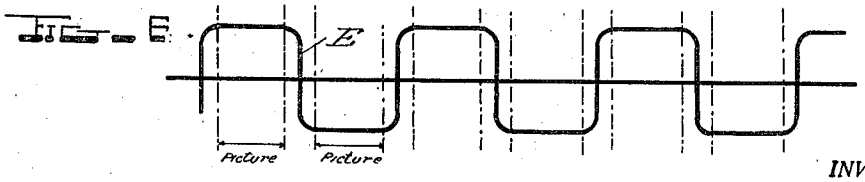


FIG. 6



INVENTOR.
Walter Soller,
BY
John B. Brady
ATTORNEY

Feb. 18, 1941. W. SOLLER 2,231,961

TELEVISION SYSTEM

Filed Aug. 3, 1938 5 Sheets-Sheet 3

Fig. 7

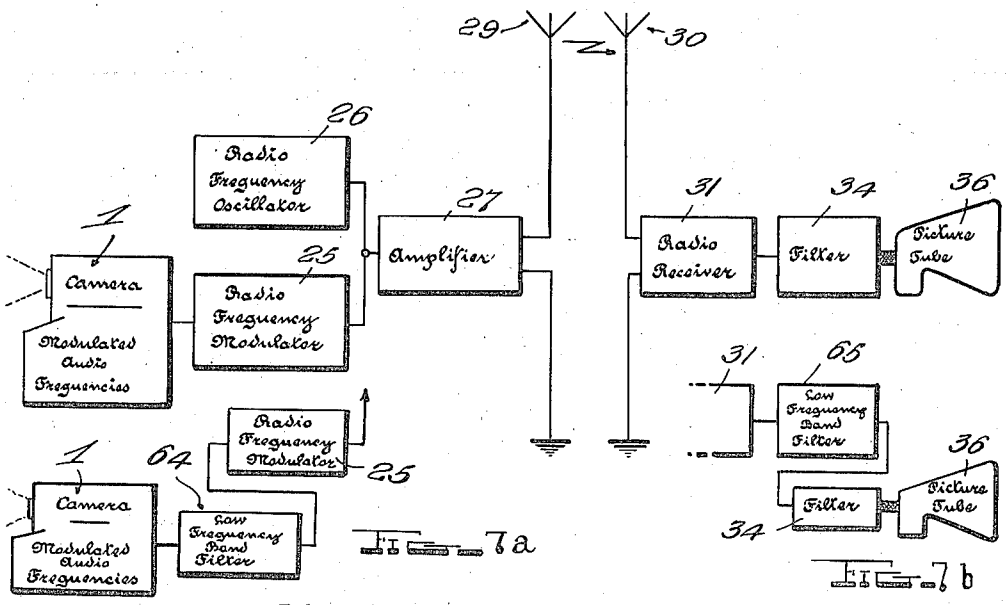
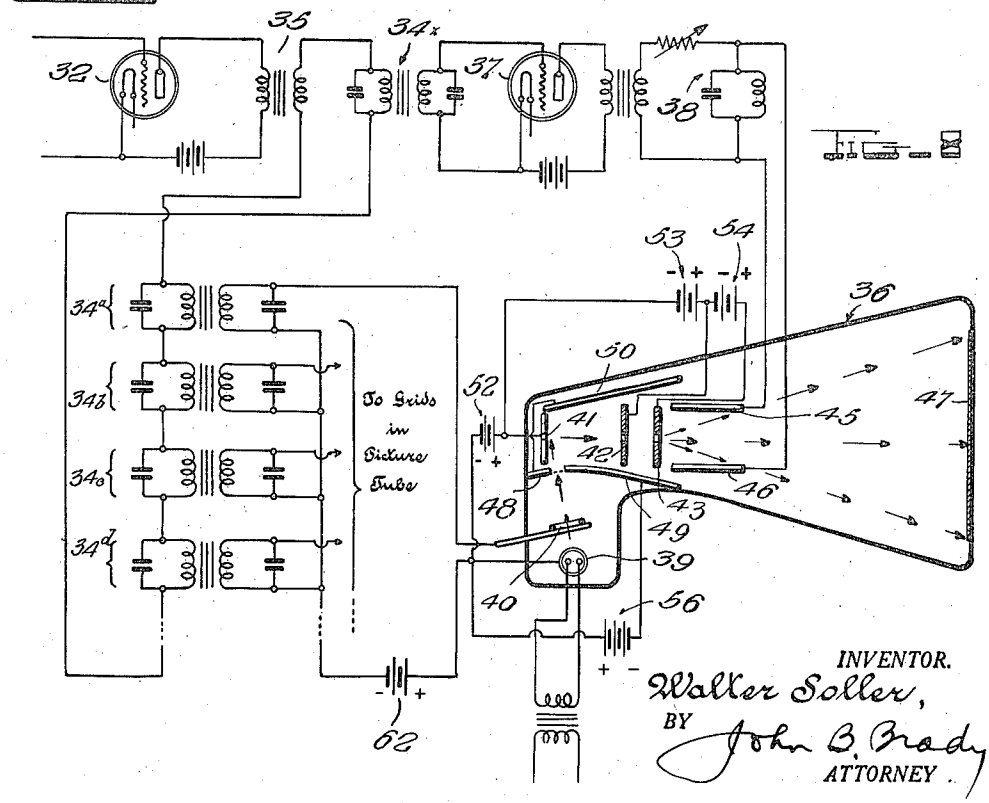


Fig. 7a

Fig. 7b



INVENTOR.
Walter Soller,
BY John B. Brady
ATTORNEY.

Feb. 18, 1941. W. SOLLER 2,231,961

TELEVISION SYSTEM

Filed Aug. 3, 1938 5 Sheets-Sheet 4

FIG. 9

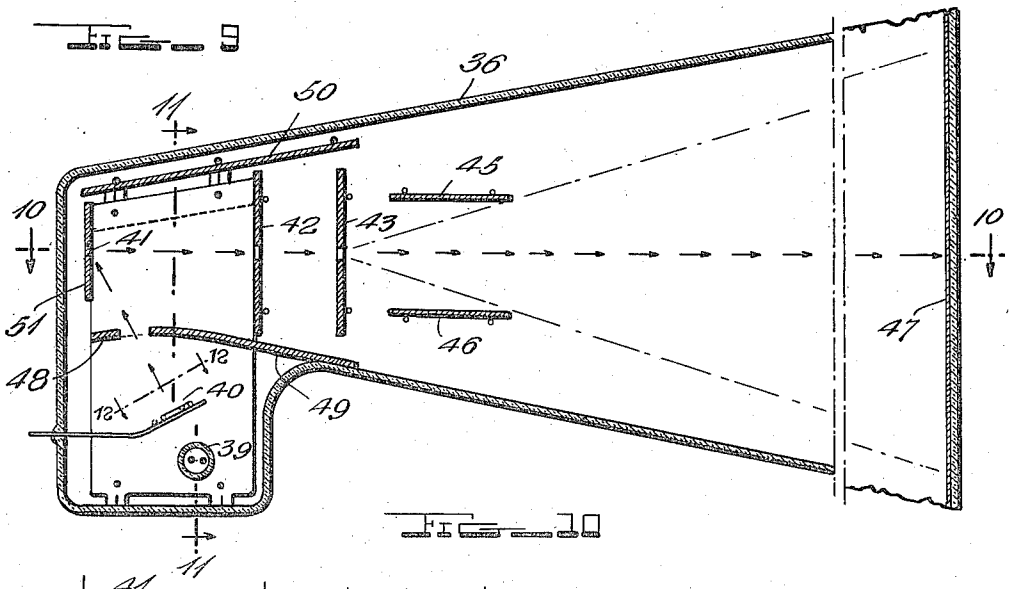


FIG. 10

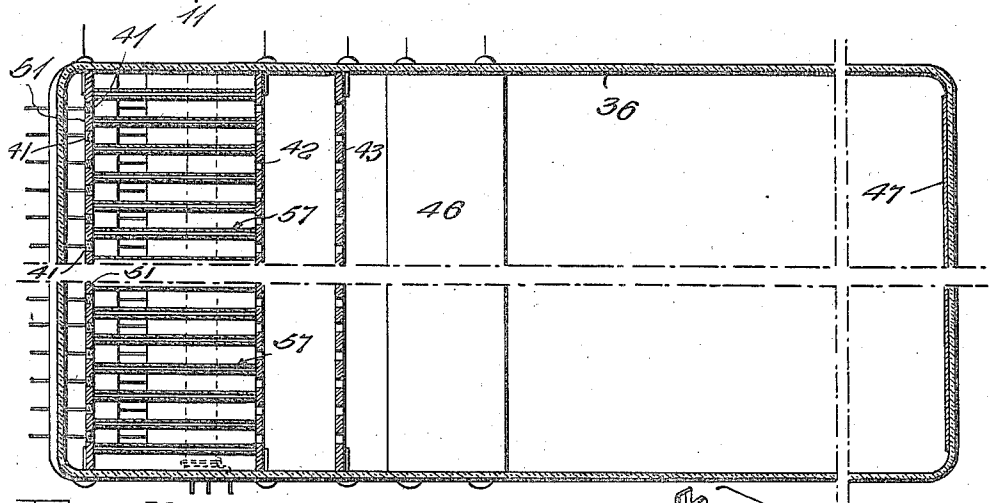


FIG. 11

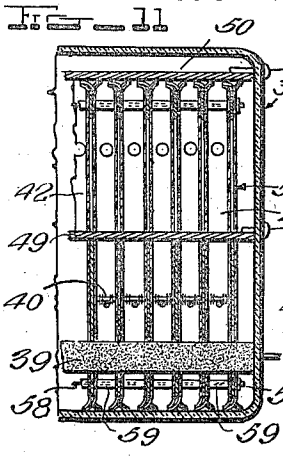


FIG. 12

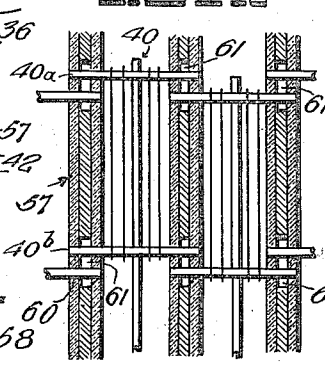
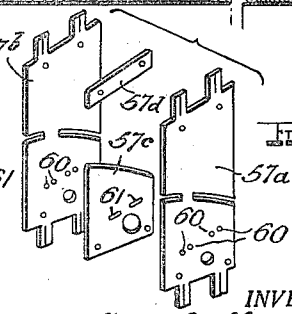


FIG. 13



INVENTOR.
Walter Soller,
BY John B. Brady
ATTORNEY.

Feb. 18, 1941. W. SOLLER 2,231,961

TELEVISION SYSTEM

Filed Aug. 3, 1938 5 Sheets-Sheet 5

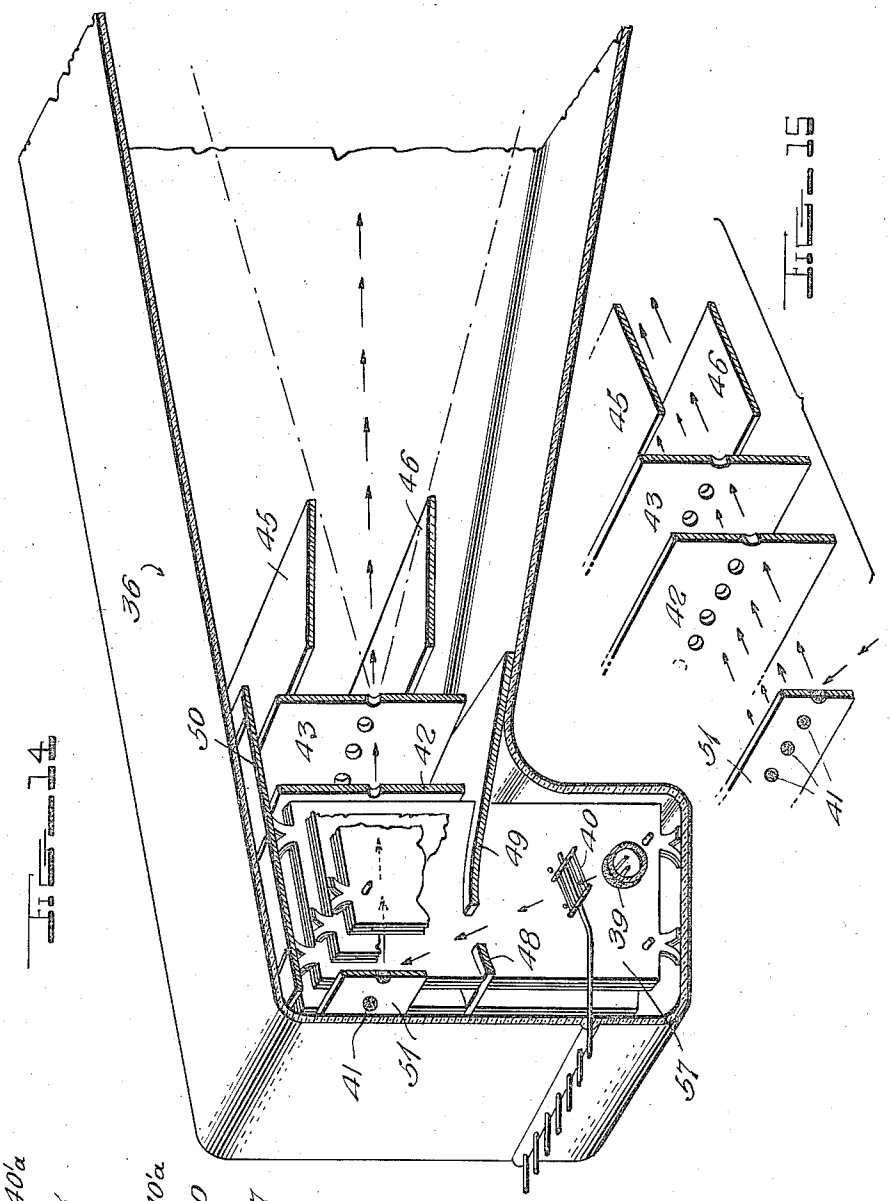


FIG. 14

FIG. 15

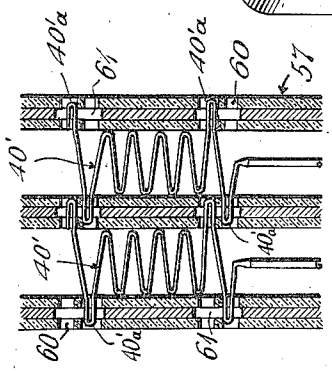


FIG. 16

INVENTOR.

Walker Soller,

BY John O. Brady

ATTORNEY.

Patented Feb. 18, 1941

2,231,961

UNITED STATES PATENT OFFICE

2,231,961

TELEVISION SYSTEM

Walter Soller, Cincinnati, Ohio, assignor of one-half to William H. Woodin, Jr., Tucson, Ariz.

Application August 3, 1938, Serial No. 222,897

11 Claims. (Cl. 178—6.8)

My invention relates broadly to television systems and more particularly to a system for the production, transmission, reception and demodulation of a plurality of light intensity modulated carrier currents simultaneously. The system and apparatus herein described constitute improvements upon the disclosures of my copending application Serial No. 733,300, filed June 20, 1934, for Television system, and Patent No. 2,189,843, granted Feb. 13, 1940, for Television system.

One of the objects of this invention is to provide a complete television system embodying a minimum of structural elements and circuit connections.

Another object of my invention is to provide a television system of extreme simplicity, operative with a minimum of control elements and with apparatus which is simple in construction and operation, so that the system is readily practicable.

Further objects of my invention are to provide television camera apparatus embodying electron beam scanning means operative under the control of a single synchronous current; and television camera apparatus producing modulated multi-frequency waves of predetermined relation combined in a single complex current which is hereinafter referred to as the "picture current."

Still another object of my invention is to provide a high frequency carrier current transmitting system modulated by a complex picture current and a single synchronizing current, of frequencies within the range embracing audible frequencies, so that the resulting transmitted wave employs a relatively narrow band in the high frequency spectrum.

Still further objects of my invention are to provide demodulating means operative on the high frequency carrier current; filter means for separating the synchronizing current and the light intensity modulated currents comprising the picture current; and demodulating and reproducing means operative with the various components of the picture current to reproduce an image in accordance with the light intensity signals in the picture current.

Still another object of my invention is to provide electron beam image reproducing means embodying a plurality of sources of secondary electron emission individually activated under control of varying cathode rays in accordance with light intensity signals, charged plate means perforated to form the secondary electron streams into an electron beam, and common deflecting means operative under control of a single synchronizing wave to effect simultaneous deflection of the electron beam.

Other and further objects of my invention reside in the apparatus and arrangements hereinafter set forth with reference to the accompanying drawings, in which:

Figure 1 is a schematic diagram of the television transmission system of my invention employing special camera apparatus; Fig. 2 is a more detailed diagrammatic showing of the camera apparatus in particular; Fig. 3 is a sectional view through the camera structure taken on the line 3—3 in Fig. 2; Fig. 4 is a greatly enlarged face view of the photo-sensitive plate element employed in the camera of my invention; Fig. 5 is a sectional view of the same on line 5—5 in Fig. 4; Fig. 6 is a graphical representation of the type of wave form preferably employed in the synchronous scanning means in the television transmission system of my invention; Fig. 7 is a diagrammatic representation of the broadly essential portions of a complete television transmitting and receiving system of my invention employing a space radio link; Fig. 7*a* is a diagram of a modification of the transmitter system shown in Fig. 7, and Fig. 7*b* is a diagram of a modification in the receiving system shown in Fig. 7; Fig. 8 is a schematic diagram of a receiving system adapted for cooperation with the transmission system of Fig. 1 in accordance with the showing in Fig. 7; Figs. 9–15 are various views of the picture reproducing tube of cathode beam type employed at the receiver in the system of my invention, the views being taken as follows: Fig. 9 is a vertical longitudinal sectional view foreshortened to afford a larger scale; Fig. 10 is a horizontal sectional view taken on line 10—10 in Fig. 9; Fig. 11 is a partial vertical cross-sectional view taken substantially on the line 11—11 in Fig. 9; Fig. 12 is an enlarged detail sectional view taken on the line and in the direction indicated at 12—12 in Fig. 9; Fig. 13 is a perspective view of the elements comprising the partition members in the picture tube, in disassemblage; Fig. 14 is a perspective cutaway view of the picture tube showing more clearly the interrelation of the various elements and indicating the paths of primary and secondary electrons, which will hereinafter be fully detailed; and Fig. 15 is a partial perspective view of the elements constituting more particularly the secondary electron system in the picture tube; Fig. 16 is a view similar to Fig. 12 showing a modified form of grid structure which may be employed instead of that shown in Fig. 12; and Fig. 17 is a cutaway side elevational view of a

modified form of camera apparatus which may be employed in the system of my invention.

In my copending application Serial No. 733,300 I have disclosed a camera with mechanical scanning means, and an alternator for the generation of a plurality of currents of different frequency. The receiving system illustrated therein is a complementary part of the transmitting system.

In my copending application Serial No. 4,393, I have disclosed more particularly frequency separation and amplifying means in combinations employing the transmitting means of my copending application Serial No. 733,300.

My present application discloses further developments in both the transmitting and receiving means and an improved system of television in the cooperation thereof. The apparatus disclosed in this application may be employed in such combination with complementary elements disclosed in my earlier applications as will be apparent to those skilled in the art.

Referring to the drawings herewith in more detail, the camera structure shown in Figs. 1–5 includes an envelope 1 having a plane transparent portion 1*a* arranged to pass light rays from an object to a photo-sensitive plate element 2 disposed within the envelope. Electron beam producing means are mounted forward of the plate element 2, and below the line of sight from the object to the plate element, the beam producing means being disposed at an angle with respect to said plate element 2 in order to direct the beam of electrons produced thereby towards the plate element.

The beam producing means, shown more clearly in Figs. 2 and 3, are conveniently mounted in a glass press portion 1*b* of the envelope 1, and include a cylindrical cathode member 3 of small diameter and having a heater element 4 within. Surrounding the cathode 3 are a pair of concentric cylindrical plate members 5 and 6 having aligned longitudinal slits 5*a* and 6*a* therein substantially coextensive with the cathode 3, and arranged to expose the cathode with respect to the plate element 2. Mounted on either side of the plane of exposure between the cathode 3 and the plate element 2, and adjacent the outer cylindrical plate member 6, are deflection control plate members 7 and 8, as shown more clearly in Fig. 3. Electrostatic shield plates 9 and 10 are mounted respectively above and below the electron beam producing means described. Electrical connections from the cathode 3, heater 4, cylindrical plate members 5 and 6, deflection control plates 7 and 8, and in common from shield plates 9 and 10 extend through the glass press 1*b*.

The photo-sensitive plate element 2 includes a conductive supporting plate 2*a*, mounted by means of a conductor 12 in a glass press 1*c* in the envelope 1. Over the face of the plate 2*a* is fixed a sheet of insulation material 2*b*, upon which photo-sensitive material 2*c* is provided in a prearranged pattern as illustrated in Figs. 4 and 5 of the drawings.

Fig. 4 shows in face view a portion of the plate element 2 with photo-sensitive material 2*c* in closely adjacent rows of evenly spaced patches of various lengths. The portion of the plate element shown in Fig. 4 embraces twenty-nine rows, or lines, from substantially the middle of the plate element and it will be noted that the row of smallest patches lies substantially across the middle of the plate element. Adjacent rows on either side of the middle row contain patches and spaces of slightly increased lengths varying in equal steps alternately on opposite sides of the middle row. Thus, greater definition will be had in the middle portion of the plate member along one dimension, while a uniform definition will be seen along the other dimension as the rows of patches are all of equal width and are equally spaced. The functional purpose of this arrangement will be more clearly understood as the description progresses.

Referring now more particularly to Figs. 1 and 2 and the circuit connections there shown, power is supplied to the heater 4 from source 14 through ballast resistance 15, which results in activation of the cathode 3 to emit electrons. Cylindrical plate members 5 and 6 are maintained at predetermined potentials with respect to the cathode 3 and each other through the source of potential 16 as shown, the relative potentials being so chosen that the electrons emitted by the cathode 3 are formed into a flat beam passing through the slits 5*a*, 6*a* and focused on the photo-sensitive plate element substantially in the manner indicated at 11 in Figs. 4 and 5.

The conductor plate 2*a* of the photo-sensitive element 2 connects with conductor 12, load resistance 17, and source of potential 18, and is maintained at a higher potential than the plates 5 and 6 with respect to the cathode 3 by connection from source 16. The positive or highest potential terminal of source 16 is grounded at 19, together with the electrostatic shield plates 9 and 10, as shown.

The conductive supporting plate 2*a* and each patch of photo-sensitive material 2*c* constitute a condenser, with the insulation 2*b* as dielectric, in the circuit between cathode 3 and plate 2*a*, which condenser becomes individually conductive as the electron beam is focused on the individual photo-sensitive patch 2*c*. The current which flows as the condenser is conductive is proportional to the light intensity on the photo-sensitive patch 2*c*.

The electron beam from cathode 3 is so formed with respect to the plate element 2 that it embraces a minute portion of each row of photo-sensitive patches. An alternating voltage having a wave form preferably as indicated in Fig. 6, is impressed on the deflection control plates 7 and 8 from alternator 20, and operates to deflect the electron beam at substantially constant speed across the plate element 2, during which the image of the object, which is focused on the plate element 2 by a lens system at 21, is scanned, and a complex picture current produced. A complete picture is scanned during each half cycle of the wave shown in Fig. 6, so that a frequency of ten cycles-per-second is satisfactory.

Bearing in mind the foregoing elements of structure, the operation of the television camera system of my invention will be clearly understood. As the electron beam progresses at constant speed across the rows of photo-sensitive patches 2*c*, a plurality of modulated currents of different frequencies will be produced in the load resistance 17, the currents being modulated by the varying light intensities on the various patches simultaneously contacted, and the currents having different frequencies because of the different numbers of patches in the several rows. It will be noted that the complexity of the picture current will be minimized by dark portions of the image and that only at exceptional instances will the picture current embrace a component for each line of the picture. The number of lines, therefore, may be increased so that maximum efficiency is effected

by operating with a picture current including normally components corresponding to approximately 80% of the lines of the picture. The receiving system which will hereinafter be more fully described must include, of course, facilities for translating the components from all lines of the picture though all of these will be simultaneously operative only at exceptional instances.

Referring again to Fig. 1, I have shown an electron tube amplifier 23 having a control grid 23a connected with the resistance 17 and biased with respect to the cathode 23b and ground 19 from the source of potential 18. The output circuit of the amplifier 23 is transformer coupled at 24 with a modulator system 25 supplied with a high frequency carrier current from oscillator 26 in the preferred form of my invention. The secondary of the transformer at 24 is connected in series with the secondary of a second transformer at 28, the primary of which connects with the alternator 20, to supply a current of synchronous frequency to the modulator 25. Modulated high frequency currents are amplified at 27 and radiated from antenna 29.

Fig. 7 indicates comprehensively a complete system arrangement employing the transmitter system hereinbefore described. Radiated energy is intercepted by antenna 30 and detected in the radio receiver 31 which includes an electron tube rectifier 32 as shown in Fig. 8. The filter 34 coupled with the receiver 31 at 35, Fig. 8, separates the components of the complex picture current and the synchronous current for energizing a picture tube device 36. As shown in Fig. 8, the filter may comprise variously tuned low frequency circuits 34a, 34b, 34c—34x, one of which, 34x, passes the synchronous current of the frequency of alternator 20 to an amplifier 37 and phase adjusting means 38.

The picture tube 36 is shown in detail in Figs. 9–16, and comprises essentially a source of primary electrons 39, control grid means 40, a source of secondary electrons 41, formative anode elements 42 and 43, deflection plates 45 and 46, a fluorescent screen 47, and various electrostatic shield members 48, 49 and 50. As shown more clearly in Figs. 9 and 14, the cathode source of electrons, 39, is disposed in a remote corner of an enlarged body portion of a cathode ray tube device. Diagonally opposite the cathode 39 and facing the screen 47 in the cathode ray tube is a conductive plate member 51 having a series of perforations for mounting material at 41 constituting separate sources of secondary electrons. Plate 51 itself will not emit secondary electrons, and the exposed area thereof may be covered with insulation material. Shield members 48 and 49 are so disposed across the enlarged body portion as to define a path therebetween by which electrons from the cathode 39 pass and are adapted to impinge on the material at 41 for causing the emission of secondary electrons. Individual control grids at 40 are provided set normal to the angular path of the primary electrons for varying the electrons passed to the separate bodies of material at 41.

As shown in Fig. 8, the control grids 40 are biased from a common source of bias potential 62 and separately energized with respect to the cathode 39 by the picture current components in the output of filter 34. Plate 51 and the sources 41 of secondary electrons are maintained at positive potential with respect to cathode 39 by source of potential 52. Formative anode elements 42 and 43 are maintained at respectively higher potentials than the plate 51 by sources of potential 53, 54, and are apertured in similar manner to the perforations in plate 51 and mounted parallel thereto so that electrons emitted at 41 are drawn through aligned apertures in anodes 42 and 43 and formed into pointed rays focused on the screen 47. Because of the arrangement of the patches of material 41 and the apertures in plates 42 and 43 the pointed rays form in the aggregate a flat beam of electrons projected at constant speed from the plate 51 and passing uniformly between deflection plates 45 and 46, which are energized by the synchronous wave from the output of filter 34 for simultaneously deflecting all of the rays across the screen 47. It will be noted that each ray varies in quantum of electrons by reason of the control of the intensity, the velocity, of the primary electrons by the several control grids 40. The flat formation of the beam of secondary electrons is more clearly apparent from Figs. 10, 11, 14 and 15, the latter being a detached perspective view of the elements constituting the secondary electron system in the apparatus of my invention.

In order to ensure accuracy and uniformity of operation of the picture tube 36, adequate electrostatic shielding is provided throughout. The shield plates 48, 49, and the plate 50 are disposed below and above the path of secondary electrons in the enlarged body portion of the tube substantially in equalized relation and are charged at the same potential from source 56, Fig. 8, so as to maintain a uniform field along the path of the secondary electrons up to the position where the deflection plates 45, 46, are effective.

Below the plates 48, 49, separately shielded compartments are provided within which the control grids 40 are individually effective. Partition members 57 comprise laminations 57a and 57b of insulation, preferably mica or the like, which extend the height of the enlarged body portion of the tube beneath the shield plate 50. These laminations are cutaway as shown clearly in Fig. 13 to accommodate the plates 48 and 49, and are adapted by slit feet to be mounted in substantial alignment in the tube. An intermediate lamination 57c of metal, such as brass, is cut to conform with the body of the insulation laminations below the cutaway portion for plates 48 and 49. In assembled position in the tube then the metal laminations 57c constitute shields between the control grid sections of the tube. The laminated partition members 57 are assembled with bolt and collar means, 58, 59, through apertures provided in the laminations. Spacer members 57d, of insulation or metal, may be employed at the upper ends of the partitions to equalize the thickness of the shield lamination 57c.

The partition members are apertured for entrance of the common cathode element 39, the aperture in the shield lamination 57c being larger than the apertures in laminations 57a and 57b, which fit the cathode, so as to insulate the shield from the cathode. The shield lamination 57c however is exposed in the cutaway portions of the laminations 57a and 57b and contacts plates 48 and 49 so as to be charged at the same potential as the shield plates 48 and 49. This connection is indicated in Figs. 9 and 11.

The partition members also provide mounting means for the control grid structures 40 which are mounted in the same plane as shown in Fig. 11, in the manner indicated in Fig. 12. Circular apertures 60 in the insulation laminations 57a, 57b, support cross bars 40a and 40b in the grid structure; other apertures 60 for mounting the

grid in an adjacent section are displaced in the plane of the grids so as to provide insulation between the separate grid structures. The shield lamination 57c is provided with elongated enlarged apertures 61 aligned with but encircling pairs of apertures 60 adapted to support adjacent grid structures, substantially as shown in Fig. 13 and indicated in Fig. 12. The shield lamination 57c is thus insulated from the grid structures.

A modified form of grid structure is shown in Fig. 16, and is particularly adaptable to the construction illustrated. The grid 40' is formed from a single wire element bent to substantially the form shown, having extended portions 40'a adapted to enter alternate apertures 60 in the partition members 57. This type of grid structure has the advantage of being adjustable which facilitates the construction of the partition and grid structure, which is assembled as a unit to be combined with the cathode and shield plates 48 and 49.

Other modifications may be made in the system and structure of my invention. A voltage of sine wave form may be employed instead of one with a wave form as illustrated in Fig. 6, but in such case it will be necessary to correspondingly vary the spacing of the photo-sensitive patches 2c in the rows on the plate element 2 so that a greater number of the patches are grouped in the middle of the row in order to produce a picture current of constant frequency. Greater definition in the middle of the image results with this arrangement.

A further modification may be found more effective in some instances, and consists as indicated in Fig. 17 in providing a constant dim illumination of the photo-sensitive plate element 2 from a light source 63, whereby a subcarrier frequency is constantly generated so that the complex picture current comprises at all times currents of the several different frequencies in the many lines of the picture, which currents may or may not be simultaneously modulated at any instant. When subcarrier currents are employed it will be necessary to vary the common bias potential for grids 49, supplied from source 62, so as to maintain cut-off potential on the grids up to the value of the subcarrier wave in order that clarity and maximum brilliance may be had in the reproduced image.

In employing the system of my invention as disclosed, circumstances may arise due to the character of the object to be televised or atmospheric or other disturbances, in which it may be desirable or necessary to curtail the number of different frequencies in the complex picture current in order to obtain greater clarity in the receiving system. Such curtailment may be simply effected as indicated in Fig. 7a by employing a low frequency band filter 64 at the transmitter for removing the lower frequencies of a desired number of the outermost lines on both sides of the middle of the image. The remaining scope of the picture will be represented in a less complex picture current which can be transmitted with greater clarity and simplicity.

A further modification along the same lines but referring to the receiving system consists in providing a less elaborate receiver and picture tube which may operate only within the vertical middle portion of the image. The number of separate filter units may be reduced and a picture tube having a correspondingly smaller number of control sections employed. With this arrangement, as shown in Fig. 7b, a low frequency band filter 65 is connected prior to the separate filter circuits 34 and limits the complex picture current to frequencies within the range of the separate filter circuits. Such a receiver may be employed regardless of the number of lines actually employed in the original transmission, and as the deflection is equal in any arrangement, satisfactory reproduction may be accomplished.

The above described limited operation in transmitter and receiver may be employed to good effect in the transmission of motion pictures which may be projected from film onto the photo-sensitive element 2 in such proportion that receivers of limited range may reproduce the entire frame. Or, if the projection be to the full size of the screen, the receiver of limited operation may reproduce the vertical middle portion thereof which ordinarily is devised to embrace the principal action of the scene.

Thus, while I have shown my invention in certain preferred embodiments, I intend that modifications may be made therein, and no limitations thereon are to be construed except as recited in the appended claims.

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

1. A television system having, in combination, a transmitter including light translating means for producing simultaneously a plurality of currents of magnitudes dependent upon light intensities and of different frequencies; said means including a photoelectric plate element having a plurality of rows of light sensitive patches with a different number of patches in each of said rows, and a flat electron beam embracing all of said rows of patches and movable along said rows in successive cycles; an electrical circuit including said electron beam for combining said currents into a complex picture current, means for transmitting said complex current, and a receiver including current translating means for producing simultaneously a selected plurality of light points of intensities dependent upon the magnitudes of corresponding currents in said plurality of currents.

2. A television system having, in combination, a transmitter including light translating means for producing simultaneously a plurality of currents of magnitudes dependent upon light intensities and of different frequencies; said means including a photoelectric plate element having a plurality of rows of light sensitive patches with a different number of patches in each of said rows, a light source disposed to direct a constant and evenly diffused illumination over said photoelectric element, and a flat electron beam embracing all of said rows in successive cycles; the currents produced by said means being modulated carrier currents of different frequencies; an electrical circuit including said electron beam for combining said currents into a complex picture current in which all rows of patches on said photoelectric element are represented, means for transmitting said complex current, and a receiver including detector means and current translating means for producing simultaneously a selected plurality of light points of intensities depending upon the magnitudes of the modulations on corresponding currents in said plurality of currents.

3. In a television system, camera apparatus comprising a photoelectric plate element having a plurality of rows of light sensitive patches with a different number of patches in each of said rows, means for focusing an image of an object to be televised on said plate element, a

source of electrons and means for forming a flat beam of electrons from said source directed upon said plate element and embracing all said rows of patches, and means for deflecting said beam across said plate element in line with said rows of patches.

4. In a television system, camera apparatus including a photoelectric plate element comprising a sheet of insulation material having on one face thereof a conductor coextensive with said sheet and on the other face thereof a multiplicity of photosensitive patches arranged in a plurality of rows each embracing a different plurality of patches, means for focusing an image of the object to be televised on the face of said plate carrying said patches, each said patch constituting in combination with said conductor a condenser charged in accordance with the light intensity thereon, an electron means for scanning said plate element in line with said rows for removing the charges from the individual photosensitive patches on said plate.

5. In a television system, camera apparatus including a photoelectric plate element as set forth in claim 4 and wherein the row embracing the greatest plurality of said patches is disposed in the middle of said plate element.

6. In a television system, camera apparatus including a photoelectric plate element as set forth in claim 4 and wherein the row embracing the greatest plurality of said patches is disposed in the middle of said plate element, and rows embracing progressively smaller pluralities of said patches are disposed alternately on either side of said middle row, whereby greatest definition in said image is obtained in the central portion thereof focused on said plate.

7. In a television system, camera apparatus comprising a photoelectric plate element having a multiplicity of photosensitive patches disposed in a plurality of rows with a different number of patches in each of said rows, means for focusing an image of an object to be televised on said plate element; means for forming an electron beam comprising an elongated cathode and a plurality of cylindrical members disposed concentrically with respect to said cathode and having aligned slots therein substantially coextensive with said cathode, means for charging said members at different potentials with respect to said plate so as to form a flat beam of electrons; said beam being directed toward said photosensitive plate element in a plane normal to the direction of said rows of patches, and means for deflecting said beam across said plate element.

8. In a television system, camera apparatus comprising a photoelectric plate element having a multiplicity of photosensitive patches arranged in a plurality of rows each embracing a different plurality of said patches, means for focusing an image of an object to be televised on said plate element, means for diffusing a constant illumination over said plate element, and means for simultaneously scanning all rows in said plurality with a flat beam of electrons; elemental portions of said beam corresponding to said rows being affected by the numbers of said patches in the respective rows, the constant illumination on said patches and the light intensity on the respective patches due to the image focused thereon.

9. In a television system, picture apparatus comprising a cathode ray tube having a fluorescent screen, a plate member having a plurality of aligned apertures filled with material constituting sources of secondary electron emission, a plurality of separate plate members having apertures therein aligned respectively with individual sources of secondary electron emission and charged with respect to said sources so as to form pointed cathode rays, said sources and said apertures being arranged in a single plane normal to said screen whereby said pointed cathode rays form in combination a flat electron beam directed toward said screen, and means for deflecting said beam across said screen; said pointed cathode rays individually being varied in intensity at said sources in accordance with light intensity signals.

10. In a television system, in combination, an electron device and cathode ray picture apparatus, comprising a closed vessel having an enlarged body portion and an elongated head portion having a fluorescent screen at the forward end thereof, a cathode disposed in a lower remote corner of said body portion, a plate member having an aperture filled with material constituting a source of secondary electrons charged as an anode with respect to said cathode and disposed diagonally from said cathode at the rear end of said head portion, a control grid mounted intermediate said cathode and said anode and adapted to be energized by light intensity signals to control the electron flow to said source of secondary electrons; a plurality of separate plate members having apertures therein aligned with the filled aperture in the aforesaid plate member and charged with respect to the aforesaid plate member for forming the secondary electrons emitted by said source into a cathode ray directed on said screen, and means for deflecting said ray with respect to said screen.

11. In a television system, in combination, an electron device and cathode ray picture apparatus, comprising a closed vessel having an enlarged body portion and an elongated head portion having a fluorescent screen at the forward end thereof, an elongated cathode disposed in a lower remote corner of said body portion, a plate member having a plurality of aligned apertures filled with material constituting sources of secondary electrons charged as an anode with respect to said cathode and disposed diagonally from said cathode and parallel thereto at the rear end of said head portion, a plurality of control grid elements mounted intermediate said cathode and said anode and adapted to be energized by light intensity signals and to control the electron flow individually to respective sources of secondary electrons, a plurality of separate plate members having apertures therein aligned respectively with the filled apertures in the aforesaid plate member and charged with respect to the aforesaid plate member for forming the secondary electrons emitted by said plurality of sources into separate cathode rays comprising together a cathode beam directed on said screen, and means for deflecting said beam with respect to said screen.

WALTER SOLLER.