

July 12, 1932.

J. H. HAMMOND, JR

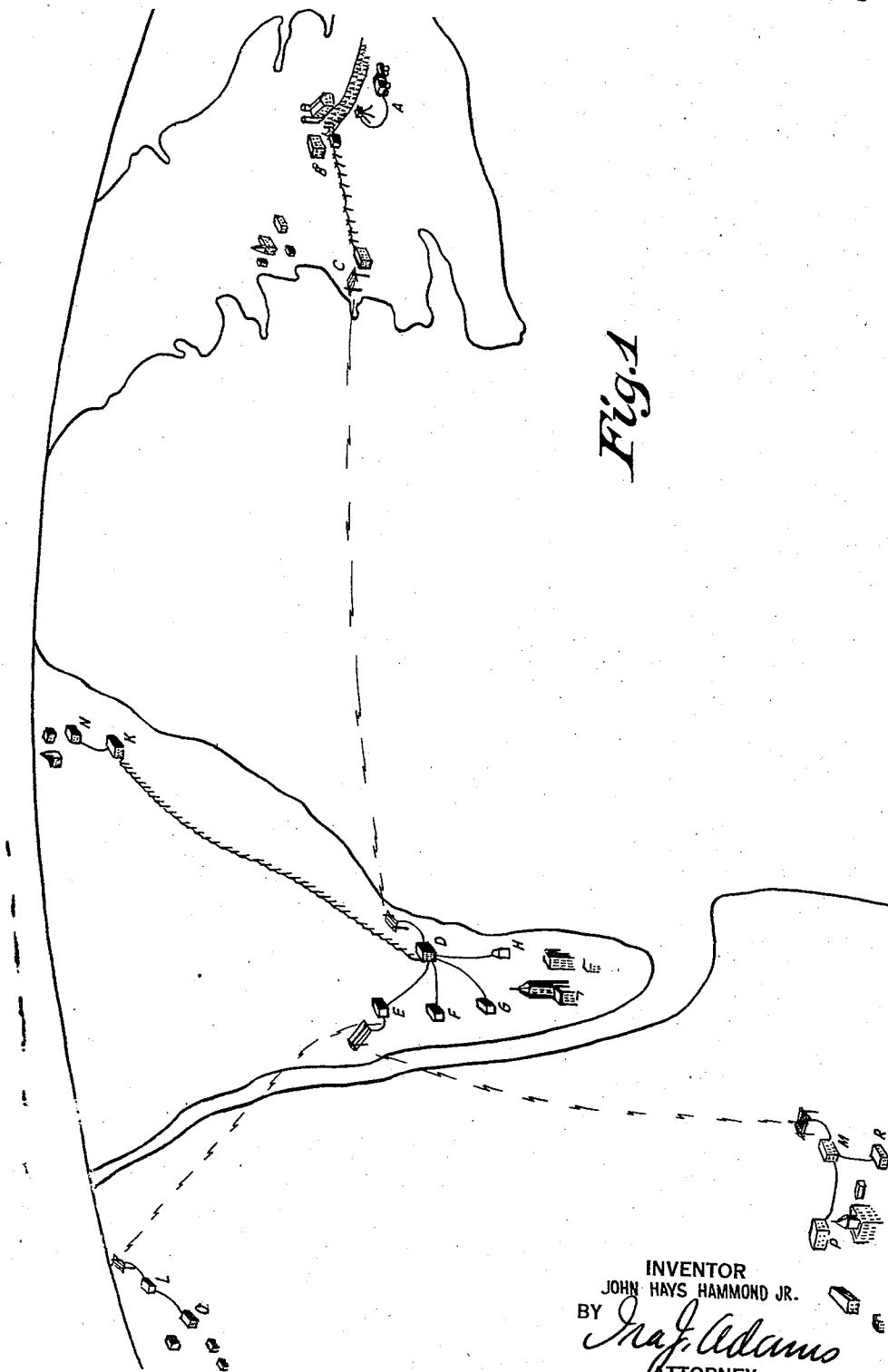
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SYSTEM OF TELEVISION

Filed Dec. 6, 1928.

6 Sheets-Sheet 1

Fig. 1



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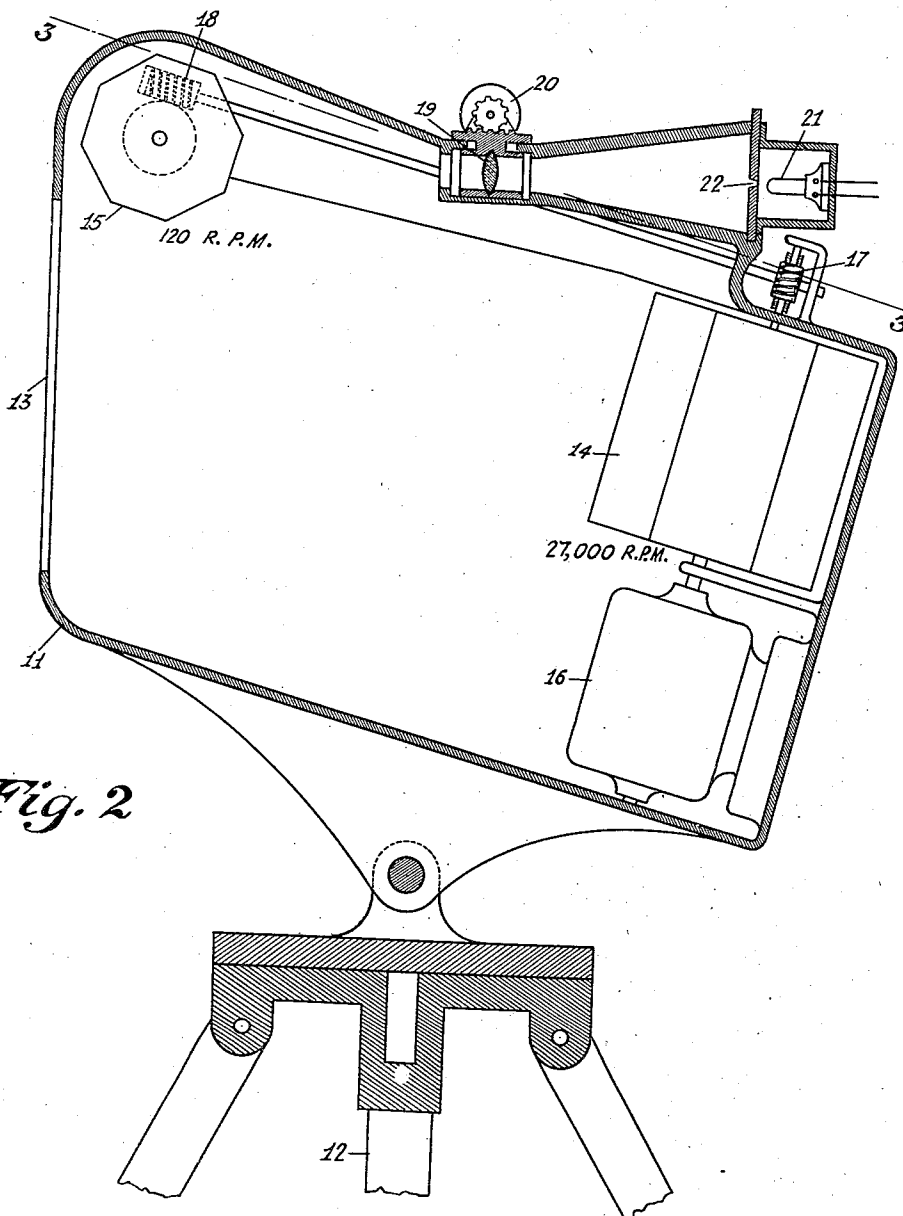
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SYSTEM OF TELEVISION

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6 Sheets-Sheet 2



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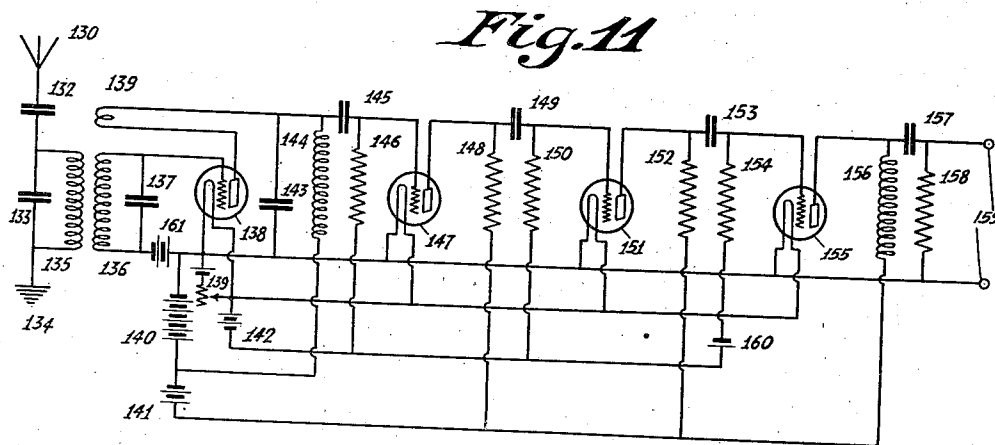
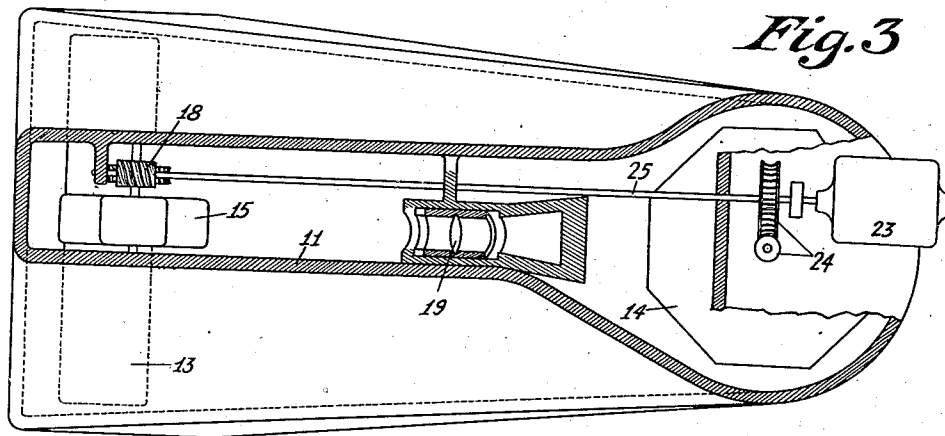
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SYSTEM OF TELEVISION

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6 Sheets-Sheet 3



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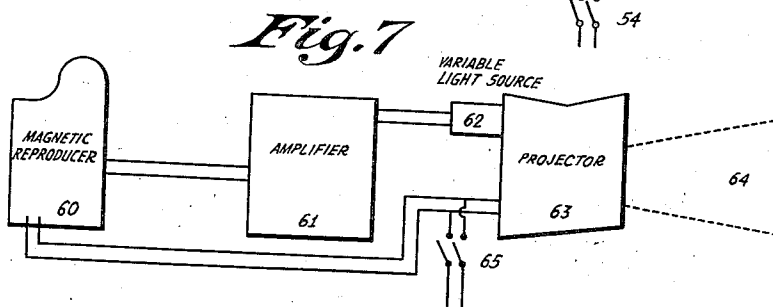
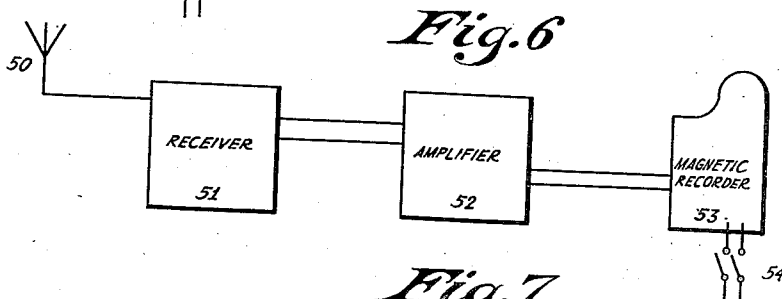
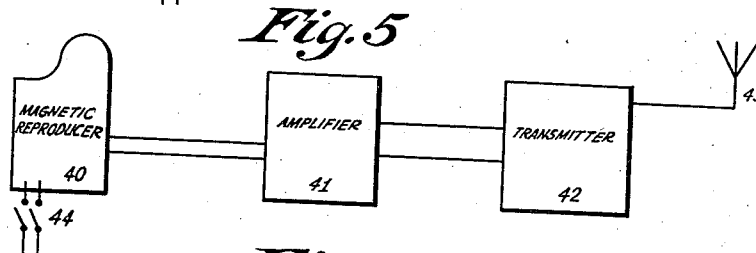
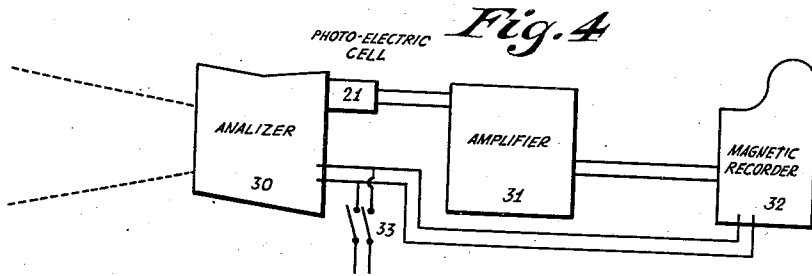
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SYSTEM OF TELEVISION

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6 Sheets—Sheet 4



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SYSTEM OF TELEVISION

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Fig. 8

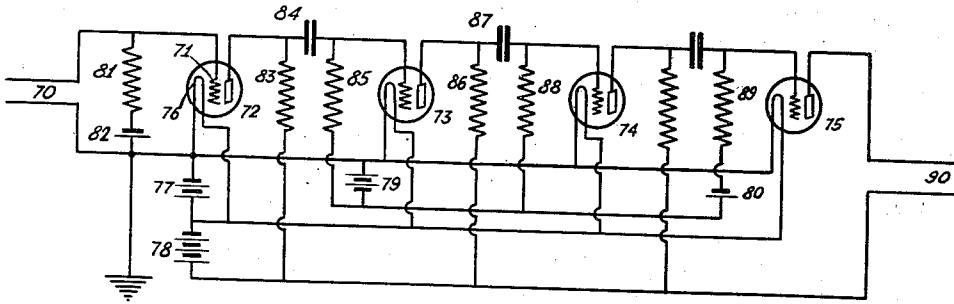


Fig. 9

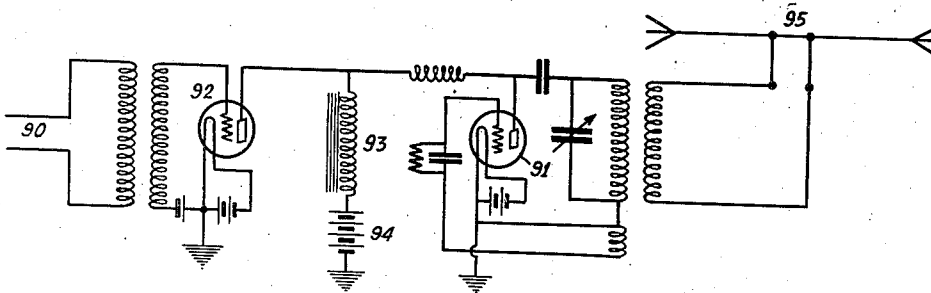
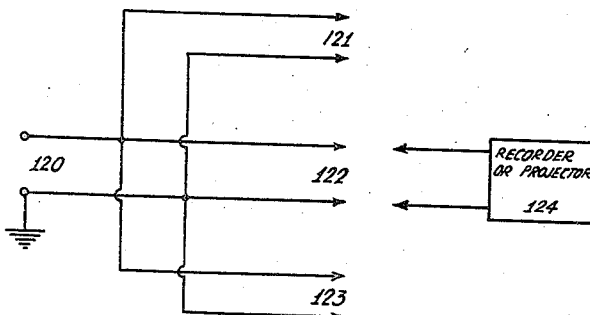


Fig. 10



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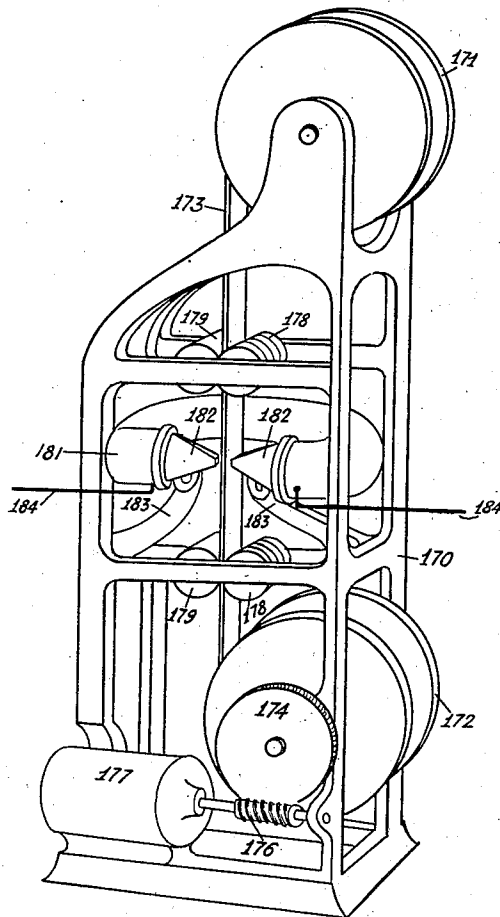
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Fig. 12



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UNITED STATES PATENT OFFICE

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SYSTEM OF TELEVISION

Application filed December 6, 1928. Serial No. 324,078.

The object of this invention is to provide means whereby events may be recorded as they transpire in a simple and efficient manner and later distributed as desired at distant points.

A further object of this invention is to provide means whereby records of transpiring events may be taken and transmitted by radio or land wire at a later period and under better conditions than would otherwise be possible.

A further object of this invention is to receive radio and land wire picture impulses and record them under laboratory conditions and later exhibit them under auditorium conditions as desired.

A further object of this invention is to transmit pictures over land wire or radio when the best conditions may exist and regardless of the time of recording the events being transmitted.

These and further objects will become apparent upon reading the accompanying specification taken in connection with the drawings.

With the present system of television it is necessary to analyze the scene occurring before the transmitter and immediately transmit it over radio or land wire receiving the impulses thus transmitted and immediately reproducing the image at the receiving end. It is obvious that if an event should take place say early in the morning in Europe it would be impracticable for people in North America to view the event at this time, as the event transpiring by Greenwich standard time would transpire 5 hours earlier than eastern standard time.

With this end in view, the present invention is directed to the design and construction of the necessary apparatus for enabling an event transpiring in London say at 9 o'clock to be recorded and transmitted over the cable or radio system when the best condition should exist and recorded or stored in North America and exhibited in the various theatres whenever desired as at the matinee theatre time or even later in the evening.

With this method also it is possible to exhibit the picture a number of times, that is,

an event which has transpired in England in the morning should be recorded and transmitted during the best hours of radio transmission during the day, received in New York and recorded on the instrumentalities provided by the inventor and then later exhibited at the shows a plurality of times during the course of the evening.

Having thus briefly described the invention attention is invited to the accompanying drawings in which:

Fig. 1 is a plan showing the utilization of the present system;

Fig. 2 is an analyzer;

Fig. 3 is a plan view of same;

Figs. 4, 5, 6 and 7 are figures showing in diagrammatic form the lay-out of the various apparatus for carrying out the invention; viz. Fig. 4 shows the scanning or analyzing means together with the amplifier and magnetic recorder, Fig. 5 shows the magnetic reproducer connected with a transmitter for transmitting the recorded television, Fig. 6 shows a receiver for receiving and magnetically recording the transmitted television and Fig. 7 shows a magnetic recorder for exhibiting or projecting the recorded television;

Fig. 8 shows the amplifier for amplifying the impulses from a photo-electric cell and feeding them to the magnetic recorder;

Fig. 9 shows the transmitter system for receiving impulses from the magnetic reproducer and transmitting them;

Fig. 10 shows the lay-out for connecting a multiple number of recorders or projectors;

Fig. 11 shows the receiving apparatus for receiving amplifying and supplying amplified television impulses to the recorder, and,

Fig. 12 is a general view of the magnetic recorder of the invention.

Having thus briefly described the figures illustrating the invention, attention is now particularly invited to Fig. 1 which is a map representing the North Atlantic Ocean with England at the right and North America at the left hand thereof.

There is shown, just taking place, some event, such as a street parade at A, say in London, England, at 11 a. m., Greenwich standard time. An analyzer and magnetic

recorder have been transported to the scene of the event on a truck and the event is recorded on the magnetic recorder. The truck then drives to the laboratory B, from the scene of the event, and the recorded picture is transmitted by land wire to C, from whence it is transmitted by radio and received at D and transmitted by land wire to the points E, F, G, and H. The time of transmission from B to C may be at say 11:30 whereas the transmission from C by radio to D may take place either at the same or a later time, say at noon Greenwich standard time. The transmission then would be received at D at 7 a. m. eastern standard time and might be either immediately transmitted to the various stations E, F, G, and, H or retained at D and transmitted at some later time, say 8 a. m. eastern standard time. Transmission to the points E, F, G, and, H of course, may take place at different times as may also the transmission to the remote points K, L, and, M either by land wire or by radio, the latter transmission being indicated as taking place from the transmitting station E to which the received impulses from England are transmitted by land wire.

The picture impulses received at the points L, K, and M would be recorded and transmitted to the motion picture houses O, N, R, and, P whenever desired and recorded there and then projected at the afternoon matinee and later in the evening as desired.

Attention is now particularly invited to Figures 2 and 3 which as has previously been stated, show the elevation and plan views respectively of the analyzer. The same general mechanism may be utilized as the projector by a proper substitution of component parts.

The analyzer comprises an enclosure 11 suitably mounted on a tripod 12. The casing or enclosure is provided with an aperture 13 through which the image of the picture is received and reflected by means of the revolving mirror wheel 14 to the revolving mirror wheel 15. For rotating the two mirrors the motor 16 is provided which is adapted to directly rotate the mirror wheel 14 and through the worm gears 17 and 18 the mirror wheel 16 at a reduced speed. The image is reflected by the two mirrors 14 and 15 focused by means of the lense 19, adjusted by the focusing screw 20, to the photo-electric cell 21 through the aperture 22.

Figure 3 shows a plan view of the analyzer taken on the line 3—3 of Fig. 2, having however, a slight modification which will now be described.

In Fig. 3, the analyzer has the driving motor 23 directly connected to the shaft 25, by means of which the motor 23 drives the rotary mirrors 14 and 15 through the gearing 24 and 18 respectively.

Fig. 4 shows the analyzer 30 equipped with the photo-electric cell 21 for analyzing the

picture to be transmitted. The photo-electric cell supplies current impulses to the amplifier 31 by means of which the impulses are amplified and recorded on the magnetic recorder 32. The analyzer 30 and the magnetic recorder 32 are driven in synchronism by means of a common connection to a given source of alternating current which is supplied through the switch 33.

Fig. 5 shows the magnetic reproducer 40 which is adapted to supply the current picture impulses to the amplifier 41 by means of which they are amplified and supplied to the transmitter 42 to be transmitted through the antenna, 43. The magnetic reproducer is driven at a fixed speed by means of constant frequency alternating current supplied through the switch 44.

Fig. 6 shows the receiver 51 for receiving the electromagnetic impulses representing the picture to be displayed and includes the antenna 50 for supplying these impulses through the receiver 51, which in turn, supplies them through the amplifier 52 to the magnetic recorder 53. The recorder 53 is supplied with the required constant frequency alternating current through the switch 54.

Fig. 7 shows the magnetic reproducer 60 which is adapted to supply the projector 63 through the amplifier 61. The amplifier 61 supplies the varying impulses to the light source 62 the light of which is adapted to be distributed or projected over the screen 64 by means of a projector 63. The projector 63 and the reproducer 60 are adapted to be driven in synchronism by the constant frequency alternating current supplied by the switch 65.

Fig. 8 shows an impedance coupled amplifier for receiving the impulses generated by a photoelectric cell and supplying them to a magnetic recorder much amplified. The impulses are impressed by means of the lead 70 upon the grid 71 and the filament 76 of the thermionic device 72. The filament 76 of the device 72 is adapted to be supplied by the low potential battery 77 in the usual and well-known manner. The tubes 73, 74 and 75 are adapted to have their filament supplied by the same low potential source 77. Across the input leads 70 of the amplifier are provided the impedance 81 and the biasing battery 82 in series. The output of the tube 72 includes the plate, the impedance 83 and the high potential source 78. For impressing the amplified potential of the plate circuit of tube 72 upon the grid of the succeeding tube 73 there is provided the coupling condenser 84 and shunted across the input of the tube 73 is the impedance 85. For providing a grid bias for the input, the biasing battery 79 is provided in the usual and well-known manner.

Similarly the output of the tube 73 includes the impedance 86 and the high poten-

tial source 78 and for impressing the amplified potential variations of the device 73 upon the input of the tube 74 there is provided through the impedance 88 by means of the common biasing battery 79. The output of the tube 74 is completed in the same manner and the input of the device 75 is also similarly arranged with the exception that additional grid biasing batteries 80 may be provided in series with the input 89 as desired. The output of the device 75 is adapted to be either directly impressed upon the magnetic recorder as will be described hereinafter, or control a transmitter for broadcasting the picture impulses. Fig. 9 shows the transmitter for transmitting high frequency oscillations modulated in accordance with the picture impulses as supplied through the amplifier shown in Fig. 8. The transmitter comprises the oscillatory circuit including the oscillator tube 91, input amplifier circuit 92 adapted to be supplied with the picture impulses through the connection 90, a signal frequency choke 93, and high potential source 94. The output of the oscillator, 91, is supplied to the antenna system, 95, in this case shown as a couple, in the usual manner.

As has been previously pointed out, Fig. 10 shows the connections for connecting a plurality of recorders or projectors. The connection 120 represents the output of a receiver amplifier and said output may be connected to a plurality of distributors terminals 121, 122, 123, etc. These terminals may be connected to either a recorder or a projector or to a transmission line for transmitting the picture impulses either by wire or by radio.

Fig. 11 shows a receiver for cooperation with the transmitter of Fig. 9. The antenna 130 is connected in the usual and well-known manner to the closed oscillatory circuit composed of the capacity 133 and the inductance 135 which circuit is inductively related to the tuned circuit composed of inductance 136 and the capacity 137 which latter circuit is adapted to impress on the grid of the thermionic detector 138 the high frequency energy received. The grid return of said detector is completed through the grid biasing battery 161 the purpose of which is to so bias the grid of the detector tube that it will perform the ordinary detector function. The plate circuit of the detector 138 includes the feedback inductance 139 and the circuit composed of the bypass condenser 143 and the signal frequency choke 144. The output circuit is completed through the high potential source 140. The rectified current impulses are impressed through the coupling condenser 145 upon the input of the amplifier device 147. The rectified current impulses are impressed through the coupling condenser 145 upon the input of the amplifier device 147.

The impedance 146 is connected across the input of the said device 147 to the proper biasing source 142 in the usual and well-known manner. The output of the amplifier device 147 is connected to the impedance 148 through the high potential source composed of the high potential batteries 140 and 141. For impressing the audiofrequency potentials upon the amplifier device, 151, the condenser 149 is provided and for impressing the proper bias upon the grid of the amplifier device 141 the grid return is connected through the impedance 150 and the biasing source 142 in the usual and well-known manner. The output of the amplifier device 151 is completed through the impedance 152 and the high potential sources 141 and 140. For impressing the audiofrequency potential on the grid of the amplifier device 155 the condenser 153 is provided. For impressing the proper grid bias upon the grid of the amplifier device 155 the grid is connected through the impedance 154 to the biasing sources 160 and 142. The output of the amplifier device 155 is completed through the output impedance 156 and the high potential sources 140 and 141. For impressing the output of the device 155 upon the output circuit, there is provided the output condenser 157 and across the output the impedance 158 is shunted in the usual and well-known manner.

Referring now more particularly to Fig. 12, there is shown the magnetic recorder which forms an important feature of the system of the invention. The recorder comprises the frame 170 which is adapted to support the two rotatable reels 171 and 172. The reels 171 and 172 are for the purpose of storing the magnetic recording tape 173 and rotation of the reels is caused by means of the gear 174 fixed to the shaft of the reel 172, and adapted to be driven by the worm gear 176 which is operatively disposed thereto and actuated by the motor 177. For guiding the tape during its passage between the reels 171 and 172 there are provided the two rollers 178 and the smooth cooperating rollers 179. Disposed between the groups of rollers and supported by the supports 183 is the electromagnet 181, the wedge shaped pole pieces 182 of which are closely associated with the moving tape 173. The winding of the electromagnet is adapted to be supplied with a varying current by the leads 184.

The operation of the system is as follows:—

In the operation of the analyzer shown in Figs. 2 and 3 when it is desired to record an event, the motor is started by closing the controlling switch (not shown). This causes the primary and secondary mirrors 14 and 15 to be rotated, the former at a high speed as for example 27,000 R. P. M. and the latter at a slow speed of for example 120 R. P. M. The light from the scenes being recorded falls upon one of the faces of the mirror 14 and is

reflected to one of the faces of the mirror 15 from which it is reflected to the lens 19 which focuses it upon the opening 22 and through the latter to the photo-electric cell 21.

5 As the two mirrors rotate, light from various portions of the scene will be thrown upon the lens 19, and to the photocell 21 in rapid succession. The mirror 14 is run at such a speed that two-hundred twenty-five faces are
10 brought opposite the opening 13 while the mirror 15 is moving from one face to the next face in front of the lens 19. In this way the mirror 14 will pick up light transversely from the scene two-hundred twenty-five times
15 while the mirror 15 is reflecting the light from the top to the bottom of the mirror 14. Thus the scene is divided up into two-hundred twenty-five horizontal lines which are successively run across the lens 19. The light from
20 each point of the scene is therefore brought successively to the opening 22 and thence to the photocell 21.

The current from this cell is then amplified by any suitable amplifying system, and the
25 output of the amplifying system connected to the magnetic recorder shown in Fig. 12 through the conductors 184. These conductors are connected to the windings of the electromagnet 181 which is made of para-magnetic material. The pole pieces of the electro-
30 magnet are wedge shaped and are located in close proximity to the magnetic tape 173 as previously stated. This magnetic tape 173 which may be of any easily magnetized material is rapidly fed from the reel or spool 171
35 to the reel or spool 172 by means of the motor 177 which is started in operation the same time as the motor 16 of Fig. 2 or the motor 23 of Fig. 3.

40 The current flowing through the winding of the magnet 181 causes rapid fluctuation in the intensity of the magnetic flux between the pole pieces of the magnet which causes a proportional magnetization in the tape 173. It
45 will thus be seen that the magnetization of the tape will be proportional to the intensity of the light received by the photo-electric cell 21 so that there will be recorded on the tape a succession of magnetization intensities proportional to the succession of light im-
50 pulses transmitted from various points of the scene being taken. The speed of the analyzing is such that it covers the field in $\frac{1}{100}$ th of a second or less as may be required and a fixed
55 ratio is established between the speed of analyzing and the speed of the tape.

When it is desired to transmit the scene which has been recorded to some distant
60 place, the magnetic tape is placed in a magnetic reproducer which is essentially the same as the magnetic recorder shown in Fig. 12. In this machine the magnet 181 is a permanent magnet or is provided with a small magnetizing coil. As the tape is passed through
65 the machine there is a variation in the mag-

netic path of the magnet and thus small current is induced in the windings of the magnet. These currents are amplified by the amplifier as shown in Fig. 8 and the output of
70 this amplifier is utilized to control the transmitter, the energy of which is radiated into space by a suitable antennae as shown in Fig. 9. The fluctuations of this energy will therefore be proportional to the fluctuations in
75 the current produced in the windings of the magnet 181, these in turn being proportional with the magnetization of the magnetic tape 173. This energy is received by a receiving and amplifying system which may be similar
80 to that shown in Fig. 11. The output of the amplifiers is connected to the windings of the magnet of the magnetic recorder similar to that already described and illustrated in Fig. 12. In this way the fluctuations of re-
85 ceived energy will be transferred to the variations in the magnetization of the second magnetic tape.

When it is desired, this magnetic tape may be put in a magnetic reproducer which is connected to an amplifier, the output of which
90 controls a variable light source in a well-known manner. The light from this source is then reflected through a lens system and rotating mirrors in a reproducer, all of which
95 are similar to those of the analyzers shown in Figs. 2 and 3 with the exception that a light source is substituted for the photo-electric cell 21. The intensity of this light source is controlled by the amplified mag-
100 netic impressions recorded upon the tape 173 of the reproducing apparatus. The light from the projector is allowed to fall upon a screen upon which it appears as a reproduction of the scene originally scanned by the
105 analyzer.

Referring now again to Fig. 1 this figure shows in a diagrammatic way the complete operation of this system. Say for example
110 that there is a parade taking place in London at 11 a. m. Greenwich time. The analyzer would be placed at A and connected to a recorder in a truck both of which could be adjacent to the line of march. After the
115 parade is over the tape from the recorder would be taken to convenient laboratory as at B from which say at 11.30 it could be transmitted by land wire to a transmitter. This transmitter could for instance be the transmitting station of Clifton, England. At a
120 convenient time, say at 12 noon Greenwich time, the tape at C would be placed in the transmitter and wireless impulses sent out which would be received at any number of
125 receiving stations. The station D located in New York, would receive it at 7 a. m. eastern standard time. From D it would be transmitted when convenient, say at 8 a. m. eastern standard time over land wires to the theatres designated F, G, and H and to the trans-
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mitting station at E, also over long distance wires to a receiver located in the station K at some distant place, such as Boston.

From the transmitting station at E, it could be sent, say at 9 a. m. eastern standard time by radio to receiving stations as L and M located for example at Buffalo and Washington.

From L the impulses could be transmitted to a theatre in Buffalo, designated as O and from M to two theatres located in Washington, designated as P and R. The tapes upon which the impulses were recorded at the various theatres, mentioned, would be stored until it was desired to display the picture, say at 2 p. m., eastern standard time, at which time they would be run through the reproducing apparatus operating the projectors described.

In this way it is seen, that an event which takes place in England in the morning, when it would not be convenient to have it shown in New York, may be stored at suitable places and transmitted at convenient times to any number of theatres where it may be displayed when it is desired.

It is of course obvious that it would be possible to reproduce the magnetic impression recorded upon the tape 173 any number of times it should be desired, as for instance the theatres might repeat the picture which they had recorded upon their own magnetic recorder a number of times.

It is to be distinctly understood that the invention is not limited to the details of the specification as the means used may be varied.

Having now described my invention, what I claim is:

1. The method of television which comprises analyzing a scene and recording the impulses produced thereby upon an electromagnetic tape, transmitting said tape to a studio, electromagnetically reproducing said impulses from said tape and transmitting the reproduced impulses, receiving and recording said transmitted impulses, at some later time reproducing said transmitted impulses and retransmitting said reproduced impulses, receiving said retransmitted impulses, recording said last mentioned impulses and at some later period of time reproducing said last mentioned recorded impulses and projecting a beam of light controlled in accordance therewith to re-form the originally analyzed scene.

2. The method of television which comprises analyzing a scene and recording the impulses produced thereby, transmitting the record of said impulses to a studio, reproducing said impulses, transmitting the reproduced impulses, receiving and recording said transmitted impulses, at some later time reproducing said transmitted impulses and retransmitting said reproduced impulses, receiving said retransmitted impulses, recording said last mentioned impulses and at some

later period of time reproducing said last mentioned recorded impulses and projecting a beam of light controlled in accordance therewith to re-form the originally analyzed scene.

3. Apparatus for television which comprises means for analyzing a scene, said analyzing means consisting of two mirror wheels mounted at right angles and adapted to revolve at such speed that one will scan the scene to be analyzed in one direction while the other will scan the scene to be analyzed a large number of times, means for producing electrical impulses varying as the light intensities of the various portions of the scene being analyzed, means for amplifying the impulses produced by said analyzing means, electromagnetic means for recording the amplified impulses, said recording means comprising a magnetic tape, reels for the storage of said magnetic tape, means for moving said reels at a predetermined speed, means for guiding the tape between said reels, and electromagnetic means interposed between said guide means for impressing thereon electromagnetic impulses in accordance with said electrical impulses, means for reproducing said recorded electro-magnetic impulses, said last means being similar to said recording means, means similar to said analyzing means for reproducing the scene originally analyzed, and means interposed between said electro-magnetic reproducing machine and said projecting machine for amplifying the impulses generated by said reproducing means.

4. Apparatus for television which comprises means for analyzing a scene, said analyzing means consisting of two mirror wheels mounted at right angles and adapted to revolve at such speed that one will scan the scene to be analyzed in one direction while the other will scan the scene a large number of times in the other direction, means for producing electrical impulses varying as the light intensities of the various portions of the scene being analyzed, electromagnetic means for recording the impulses thus produced, said recording means comprising a magnetic tape, reels for the storage of said magnetic tape, means for moving said reels at a predetermined speed, means for guiding the tape between said reels, and electro-magnetic means interposed between said guide means for impressing thereon electro-magnetic impulses varying in accordance with said electrical impulses, means for reproducing said recorded electro-magnetic impulses, said last mentioned means being similar to the recording means, and means similar to the said analyzing means for reproducing the scene originally analyzed.

5. Apparatus for television which comprises means for analyzing a scene, means for producing electrical impulses varying as the light intensities of the various portions of the scene being analyzed, electromagnetic

means for recording the electrical impulses,
said recording means comprising a magnetic
tape, reels for the storage of the tape, means
for moving said reels at a predetermined
5 speed, means for guiding the tape between
said reels, and electro-magnetic means inter-
posed between said guide means for impress-
ing thereon electromagnetic impulses varied
in accordance with said electrical impulses,
10 means for reproducing said recorded electro-
magnetic impulses, and means similar to said
analyzing means for reproducing the scene
originally analyzed.

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