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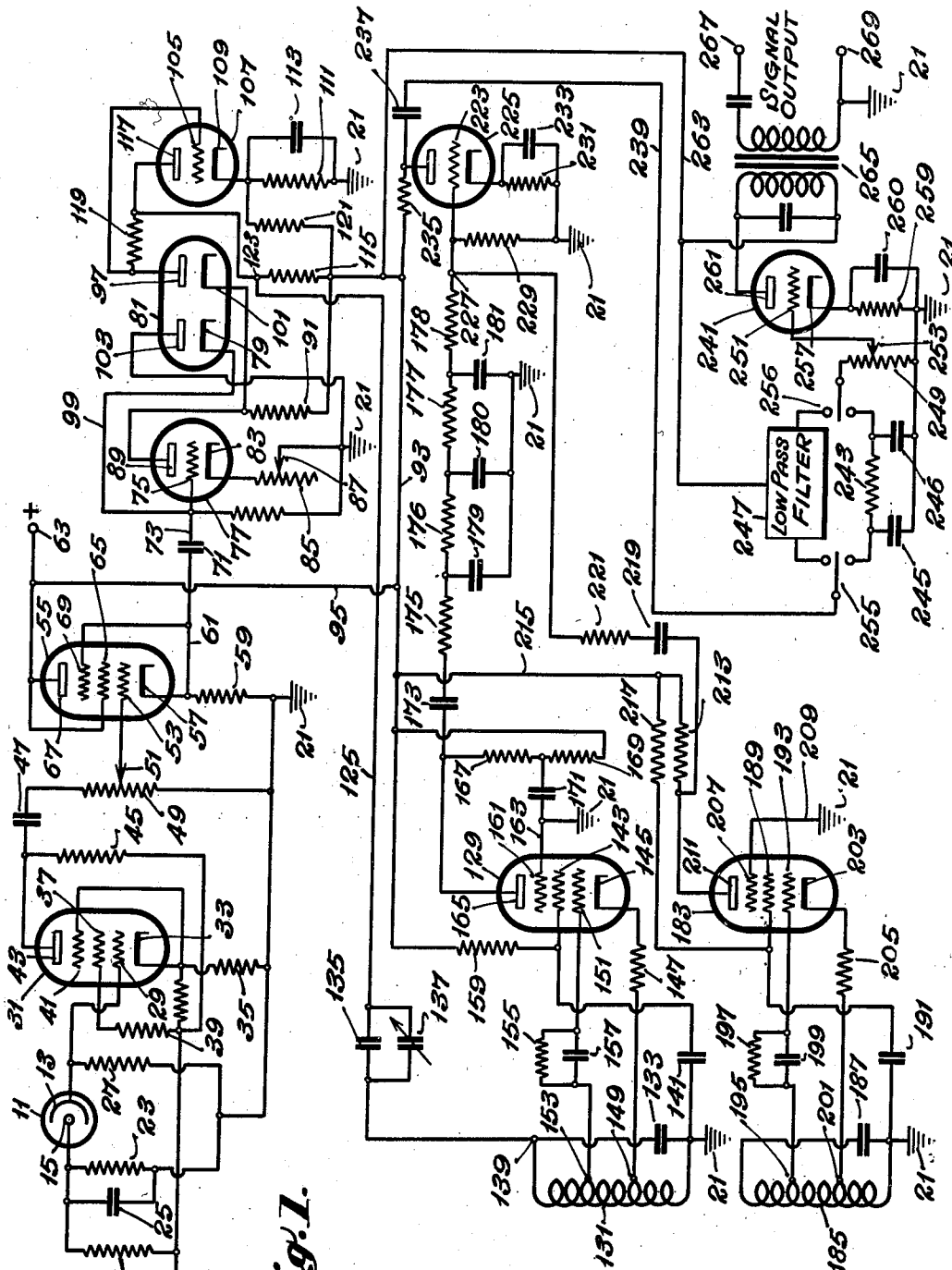
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FACSIMILE APPARATUS

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FACSIMILE APPARATUS

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This invention relates to facsimile apparatus and is particularly concerned with that type wherein provision is made for either marking or spacing signals to the exclusion of signals representing intermediate values.

The system is thus particularly applicable to the so-called "black and white" forms of transmission and reception to the exclusion of the so-called "half-tone" or modulation method.

In the form of system herein to be disclosed, provision is made for a scanning arrangement for producing signals which are adapted to develop impulse signals in accordance with the shade values on the subject scanned where the impulse signals for one condition of light and shadow are of a different form or period from the impulse developed to represent a second condition of light and shadow.

In one form of the arrangement of the invention, it is particularly adapted for the so-called "tape" type of facsimile wherein a record tape is fed through a scanning instrumentality from which, in accordance with the presence or absence of marking indicia on the subject which is scanned, there will be produced signal energy of two different characteristics, for example, frequency, which will be determined by the presence or absence of marking signals.

The system is thus particularly adapted for the transmission of signal energy to receiving points where the transmitted signal energy is particularly related to the scanning of messages of printed form where there is a variance between black and white. One example of this form of transmission would be the scanning of any form of printed, written or typewritten material.

The system is also particularly adapted for the more usual types of scanning where the scanned subject is more in the nature of a silhouette, so that distinctions are made between the black and white values of light and shade.

The invention has been illustrated in one of its preferred forms by the drawings, wherein:

Fig. 1 is a diagrammatic representation of the transmitter portion of the system; and,

Fig. 2 is a diagrammatic representation of the recorder amplifier.

The transmitter assembly, as herein incorporated and illustrated, does not show the scanning instrumentality per se, since such devices are well known in the art and any desired form may be used.

One suitable form of transmitter-scanner arrangement which has proven satisfactory in actual use is that wherein a prismatic member is rotated at a predetermined speed relative to the subject from which the transmitted signals are to be initiated. The prism, as it rotates, is adapted

ed to cause a spot of light which is directed upon the prism from a suitable light source of substantially point size, to trace laterally across the subject, and thence, either by transmission of the light through the subject, where the subject is a substantial transparency (as, for instance, a film), the lights and shadows control the current flowing in a photocell or, where light is reflected from the subject in well known manner, where the subject is non-transparent, the reflected light is picked up by a photocell and the current output therefrom is varied in accordance with the variations in light and shadow on the subject.

Referring now to the drawings, and particularly to the scanner and its amplifier, the light as reflected from, or directed through, the subject is caused to reach a photo-tube 11 and thereby to vary the photo-electronic current flowing through it in accordance with the amount of light reaching the cathode 13, so that more or less current flows to the anode 15.

There is connected to the anode 15 a suitable source of positive voltage (not shown) which is connected at the terminal 17 and is supplied to the photo-tube 11 through the resistor 19. The anode 15 also connects to ground 21 by way of the resistor 23 and the shunting condenser 25.

Output energy from the photo-tube 11 is derived from the voltage drop occurring across the resistor 27 which connects between the cathode 13 and ground 21.

Connected to the junction between the resistor 27 and the cathode 13 of the photo-tube 11 is a connection to supply a control voltage, measured by the voltage drop occurring across the resistor 27, to the signal or #1 grid 29 of an amplifier 31 whose cathode 33 is suitably biased relative to ground 21 by the resistor 35, and whose #2 grid 37 derives suitable voltage by way of the resistor 39. The #3 or suppressor grid 41 connects to the cathode in the usual manner, while the anode or plate 43 derives its suitable plate voltage from the source connected to the terminal 17 by way of the load resistor 45.

In accordance with signal energy applied to the control grid 29, it can be seen that illumination of the photo-tube 11 will cause an increase of current flowing through the tube 31 by reason of the fact that electrons are released from the photo-cathode 13, with the result that the control grid 29 becomes slightly more positive with increased light on the photo-tube.

Output energy from the amplifier stage 31 is fed through the coupling condenser 47 to a potentiometer 49 of which the adjustable tap 51 connects to the signal control or #1 grid 53 of the amplifier tube 55. The end of the potentiometer 49 opposite that connected to the condenser 47 connects to ground at 21.

The cathode 57 of the tube 55 is provided with the usual cathode load resistor 59 from which output energy is derived by means of the connection provided by conductor 61, so that, measured in accordance with the current flowing through the tube 55, voltage drops will be produced across the cathode resistor 59 connected between the cathode 57 and ground 21, with the result that a signal output is derived from the amplifier tube 55 which is a measure of the light impinging upon the photo-tube 11.

The tube 55 has plate or anode voltage supplied to it from a suitable terminal point 63 to which a source of suitable voltage (not shown) is connected. The other connections of the tube are substantially of generally known form with the #2 grid 65 connected to the anode 67, as illustrated, and the #3 or suppressor grid 69 connected in known manner to the cathode 57. This arrangement provides a low impedance output for controlling the frequency of a local oscillator in a manner which will hereinafter be explained.

For the purpose of adjusting the level of the signals and the signal output from the tube 55, the adjustable contactor 51 of the potentiometer 49 is provided. This sets the level of the output signals which will be measured, and, in accordance with the present description, it will be a measure of the black or marking signals. Output energy from the amplifier tube 55, as derived across the cathode resistor 59 and impressed upon the conductor 61, is then fed through a coupling condenser 71 in such a manner that signal energy, as it appears in the conductor 73, will be of positive polarity for black or marking picture signals which are impressed simultaneously upon the control electrode 75 of a clipper control tube 77 (which, where desired, need not be a separate tube, as illustrated, but which may comprise but half of the elements within an appropriate tube envelope and have its counterpart formed, for instance, as a detector tube 225, which will hereinafter be referred to).

Signal energy, as it appears at the conductor 73, is also applied simultaneously to one cathode 79 of a double diode tube 91 which will function as a bias and a clipper tube. The cathode 83 of the clipper control tube 77 connects to ground 21 in known manner by way of the bias control resistor 85 of which the variable tapping point 87 is arranged to set the white control level as distinguished from the black control level determined by the adjustable contactor 51 of the potentiometer 49.

Signals, as they are impressed upon the clipper control tube 77 cause, for black in the picture, an increase of current flowing through the tube 77, so that output energy derived from the plate or anode 89 of the tube 77 will produce a voltage drop in the output load resistor 91, through which resistor plate or anode voltage is supplied to the tube 77 by virtue of the connection established through conductors 93 and 95 of the terminal point 63. As current tends to flow through the tube 77, voltage drops take place across the resistor 91 in such a manner that increased current flowing in the tube 77 causes the cathode potential of the cathode 101 to decrease relative to its anode 97.

Signal potentials, as applied through the conductor 73 to the control electrode 75 are simultaneously applied through the conductor 99 to the cathode 79 of one half of the diode 81, so that for signal impulses of positive sign, that is, representing black in the picture, the potential of

the cathode 79 relative to its anode 103 will rise to prevent current flow through this half of the tube. Under conditions where black in the picture is maintained (that is, a signal of positive sign), the condenser 71 tends to charge.

If now, the signal changes, for instance, to a white signal, so that the impulse is negative in sign, then the potential of the cathode 79, relative to its anode 103, will tend to fall and current will flow through the half of the tube 81 between the cathode 79 and the anode 103. Under such circumstances the cathode 79 tends to go below ground potential when going to white in the picture, and under such circumstances the condenser 71 is discharged by the flow of current within the first half of the tube 81, as above described, and thus prevents overshooting on a change from black to white by way of the low impedance path.

The current flowing in the clipper control tube 77 determines the current flow through the half of the diode 81 between the cathode 101 and the anode 97. It will be seen that with an interruption of current flowing in this half of the bias and clipper diode tube 81 (that is, with "white" in the transmitted copy), the potential at the control electrode 105 of the control tube 107 will rise relative to its cathode 109 so that the tube 107 draws plate current. The cathode 109 of this tube connects to ground 21 by the usual cathode resistor 111 and the by-pass condenser 113.

Under these circumstances, current tends to flow through the tube 107 and thus provides a low impedance path from the junction 123, through the anode 117 and cathode 109 of the tube 107, and thence through the network consisting of the resistor 111 and condenser 113 to ground at 21.

The resistor 119 connected between the anode 117 and the control electrode 105 of the reactance tube 107 is for the purpose of applying negative feedback in the system, and the arrangement provided by the cathode resistor 111 and its shunting condenser 113, as well as the resistor 121, is somewhat of the nature of a bleeder combination which causes the cathode 109 normally to be at a positive potential. Normally, a very small current flowing in the diode section between the cathode 101 and the anode 97 will carry the control electrode 105 of the tube 107 beyond its cut-off point, so that the low impedance path from the junction point 123 through the tube 107 and the capacitor 113 is removed.

The control tube 107 will, as hereinafter to be pointed out, control the frequency developed by an oscillator tube 129 in a manner later to be described herein. The oscillator tube 129 is adapted to develop a variable frequency, depending upon the action in the tube 107 and whether or not the tube 107 is conducting.

In its preferred form, the tube 129 comprises the usual cathode and anode or plate with a plurality of grid or control electrodes. A tube particularly suited for the purpose is one known in the art as the 12SJ7, although other tubes readily may be substituted.

In the arrangement as herein constituted, the oscillatory tank circuit comprises the inductance 131 having one terminal connected to ground 21 and its other terminal connected to one end of a shunting condenser 133 across which, in parallel, is the capacity combination comprising the condenser 135 and its trimming shunting condenser 137 which connects on the one hand to the junction point 123, and on the other hand to the

connection point 139 between the inductance 131 and the condenser 133. The operation of this arrangement will later be described.

The end of the inductance 131 which is connected to ground 21 also connects by way of the coupling condenser 141 to the #2 grid 143 of the tube 129, and the cathode 145 of this tube connects via a resistor 147 to an intermediate point 149 on the inductance element 131. Likewise, the #1 grid 151 of the tube 129 connects at a point 153 on the inductance 131, which is relatively close to the end thereof, through the usual grid leak resistor 155 and grid condenser 157 to form an oscillatory circuit. In this instance the #2 grid 143 serves generally as the plate or anode element of the oscillator, insofar as the operation of the oscillatory circuit is concerned, and it derives positive potential through the resistor 159 which connects through the conductors 93 and 95 to the positive potential terminal 63.

In the arrangement shown, the #3 grid 161 connects to ground 21 via the conductor 163. The plate or anode 165 of the variable oscillator tube 129 derives its plate potential through a pair of resistor elements 167 and 169, of which the latter connects to the positive terminal 63 via the conductors 93 and 95, and the junction point of the resistors 167 and 169 is connected to ground 21 via the condenser 171.

Output energy from the oscillator tube 129 is then fed by way of a coupling condenser 173 to a filter chain comprising a group of series resistance elements 175, 176, 177 and a terminating resistance element 178 which are respectively by-passed to ground 21 by the shunt condensers 179, 180 and 181.

Under conditions when the controlling tube 107 is not drawing current, it will be appreciated that the tube impedance is increased to a maximum and is, in effect, a substantially open circuit, so that under such circumstances the parallel condenser elements 135 and 137 are ineffective to alter the natural oscillatory frequency of the oscillator tube and its oscillatory circuit. This is a state of minimum capacity across the inductance 131 and thus the higher of the two limit frequencies. At times when the control tube 107 is conducting, it will be appreciated that the parallel combination provided by the condensers 135 and 137, together with the low series impedance provided by the control tube 107, forms a parallel combination shunting the condenser 133, in that the cathode 109 of the control tube 107 connects to ground (the connection point of the second terminal of condenser 133) via the bleeder combination provided by the resistor 111 and the condenser 113. This is a condition when the capacity across the inductance 131 is a maximum and thus the resonating frequency of the tuned circuit is at the lower of the two limiting frequencies.

Thus, it can be seen that for time periods corresponding to the receipt of positive signals, that is black in the picture as assumed above, the condenser 133 alone (that is, ignoring, of course, the inductance element 131) will determine the frequency at which the oscillator 129 develops output energy, while for white in the picture (that is, negative impulses in the conductor 73), the frequency of the oscillator will be determined by the value obtained from the combination of the condenser 133 shunted by the series combination of the impedance of the control tube 107 which is serially connected with a parallel combination

of the condenser 135 and its trimming condenser 137 so that, as can readily be appreciated, the oscillator frequency varies from a change between black and white in the picture or scanned subject as it influences the photo-tube 11.

For this type of operation, the tube 107 acts as a low resistance path from one side of condensers 135 and 137 to ground when the control electrode 105 of the reactance or control tube 107 is at zero bias. Accordingly, the capacities 135 and 137 in series with such a low resistance will be placed in shunt across the tuning condenser 133. However, when the control electrode 105 of the control tube 107 is biased to a cutoff state, the low resistance path herein described is opened, so to speak, and the capacities 135 and 137 return to ground through the high resistance 115.

Also, for the purpose of developing output energy there is provided a second oscillator tube 183 which develops oscillatory energy in a manner substantially similar to that described for tube 129, except that the frequency thereof remains substantially fixed, except for normally encountered drift, unless crystal stabilization is utilized where desired.

In the oscillatory tank circuit of the tube 183 there is provided the usual inductance element 185 and the shunting parallel condenser 187, with the connection of the junction point of these two elements to ground 21 being provided.

As was hereinabove explained in connection with the oscillator tube 129, the ground terminal point of the condenser 187 and the inductance 185 connects to the #2 grid 189 of the tube 183 via the coupling condenser 191 and the #1 grid 193 of the tube 183 connects to the outermost connection point 195 on the tank circuit via the usual grid leak resistor 197 and grid condenser 199, and the most central point 201 on the inductance element of the tank circuit connects to the cathode 203 of the tube via the resistor element 205, all as above explained in connection with the oscillator 129.

As was also above noted, the #3 grid 207 connects to ground 21 via a conductor 209 and the anode or plate 211 connects to the conductor 93 via the resistor 213 and conductor 215, so that positive potential is applied to the electrode member 211.

For applying a positive potential to the #2 grid 189 there is provided a resistor 217 which also connects to the source of positive potential 63 via the conductors 215, 93 and 95.

Again, as explained in connection with the tube 129, the #2 grid 189 serves, insofar as the oscillator is concerned, as a plate element. Output energy derived from the oscillator combination, which, for instance, may be of the order of 50 kilocycles, is then fed by way of the coupling condenser 219 and the stabilizing resistor 221 to the control electrode 223 of a detector tube 225. The energy output of the oscillator 129 is fed through the stabilizing resistor 178 which is connected with the resistor 221 at the junction point 227 and is also supplied to detector tube 225.

The output of the oscillator tube 129 varies within a range of the order of about 800 to 1000 cycles, depending upon whether or not the condenser 133 is shunted by the other condensers hereinabove described, and the normal oscillator frequency of the oscillator 129 is so set that the beat frequency between the outputs of the oscillators 129 and 183 normally varies within a range of about 1000 to 1800 cycles, depending upon the

polarity of the signal pulse in the conductor 73 as supplied by way of the condenser 71.

Signal energy output from the two oscillators 129 and 183 is, as above stated, applied to the control electrode 223 of the detector tube 225 which is grid biased by means of the resistor 229 connected between the grid or control electrode 223 and ground 21, and suitable cathode bias is applied by way of the bias resistor 231 which is suitably by-passed for high frequencies by the usual condenser 233.

Plate or anode potential for the detector tube 225 is applied by way of the conductor 93 through the resistor 235, and output from the detector is then fed by way of the coupling condenser 237 to the conductor 239.

The conductor 239 feeds the output energy from the detector 225 to an audio frequency amplifier 241. The energy output of the detector is passed either through a filtering network represented by the series resistor 243 and the shunt capacitors 245 and 246 which are connected to ground 21 as indicated, or through a low-pass filter of well known type and conventionally represented at 247, and thence through the volume control resistor 249 to be impressed upon the grid or control electrode 251 of the amplifier tube 241 in accordance with the position of the adjustable contactor 253 of the volume control 249.

In order to determine whether the energy output of the detector 225 is fed by the tube 241 through the filter consisting of the series resistance 243 and the shunt capacitors 245 and 246, or through the low-pass filter 247, suitable switching elements 255 and 256 are provided which, when in the lower position, connect the filtering network consisting of the series resistance and shunt capacity, and, when in the upper position, connect the low-pass filter each serially with the conductor 239 and the volume control element 249.

The cathode 257 of the amplifier 241 is suitably biased relative to ground 21 by means of the cathode bias resistor 259 and may, if desired, be shunted by the by-pass condenser 260. Anode or plate potentials for applying operating voltages to the anode or plate element 261 of the tube 241 are supplied by way of the conductor 263 in known manner, and output energy from the tube 241 is fed by way of the transformer 265 to the output terminals 267 and 269, of which the latter terminal is effectively at ground potential 21.

As was hereinabove explained, it was possible, where desired, to combine certain of the tubes shown herein separately in single envelopes, and for this purpose it is quite obvious that the clipper control tube 77 and the detector tube 225 for instance, may be combined within a single amplifier, and, under such circumstances, a tube of the general type known in the art as the 12SL7GT has proven satisfactory, although naturally other forms of tubes may be used, as desired.

Similarly, the control tube 107 may be combined into a single envelope with the audio frequency amplifier tube 241, and under such circumstances, a tube of the type known in the art as the 12SN7GT has proven satisfactory, although other forms may be substituted as desired.

It is of course apparent, in any event, that where combinations of a tube within a single envelope have been made, the tubes are, to all practical intents and purposes, effectively separate tubes, since the electron flow within the tubes is

in all respects separately controlled and the net effect is a general reduction in the number of tubes in the system.

The output terminals 267 and 269 are then connected to energize any desired and suitable form of transmitter arrangement (not shown) for the purpose of transmitting signals to remote points. Under some conditions, when it is desired to monitor the signals appearing on terminal points 267 and 269, without transmission, these terminal points may be connected to suitable input terminal points 287 and 289 (see Fig. 2) from which the energy is passed to a band pass filter 291. However, under usual conditions, the receiver arrangement particularly shown by Fig. 2 may act as a monitor for the signals transmitted from the transmitter arrangement of Fig. 1 by connecting the terminal points 287 and 289 of the receiver instrumentality to any suitable form of receiver, and tuning that receiver then to the transmitter frequency with which energy from the terminals 267 and 269 is radiated.

The filter 291 may be of any conventional form and type as is well known in the art, and is accordingly illustrated only in a schematic form. The output of the filter 291 is then applied to the primary winding 293 of an input transformer 295 whose secondary windings 297 and 298 have their innermost terminals connected at a point 299 to which point suitable bias voltage is supplied by way of the conductor 301 which connects to an input bias control resistor 303 having one terminal connected to ground 21 and the other terminal connected to a terminal point 305 at which a positive biasing voltage is applied. The other terminals of the secondary windings 297 and 298 connect to the cathode elements 307 and 308 of a threshold limiter tube 310 having included therein the usual anode elements 311 and 312. This tube may be of the general type known in the art as the 12H6, for instance, and it serves as a usual rectifier device.

The anodes of the tube connect through resistors 313 and 314, at which the junction point 315 is connected to ground 21 by way of a suitable conductor 316. In this way it will be apparent that the tube 310, in a non-operating state, has its anodes or plates 311 and 312 connected to ground 21, and the cathodes 307 and 308 are then biased slightly positive relative to ground by means of the bias resistor 303.

When signals are received by way of the transformer 295, the negative signals, as impressed upon the cathodes 307 and 308, cause the tube to draw current when the negative signals exceed the predetermined input bias.

The output from the tube 310, as it appears across the resistors 313 and 314, is then supplied by way of the conductors 317 and 318 to the control electrodes 319 and 320 of a suitable peak limiting tube 321. This tube may be of the general type known in the art as the 12SC7, although other tubes may be equally well used.

The cathodes 322 of this tube are connected to ground in well known manner, and the anodes 323 and 324 connect to the outermost terminals of a discriminator of the primary windings 325 of a discriminator transformer 326. The centermost point 327 of the transformer primaries 325 is connected by way of conductor 328 to the bias terminal 305, which thus supplies the plate or anode potential for the peak limiting tube 321.

Generally speaking, the threshold limiter and peak limiter arrangement, herein described to incorporate the threshold limiter tube 310 and

the peak limiter tube 321, will be seen to be of the general nature shown and described by Mathes Patent No. 2,267,120 of December 23, 1941, for instance. Thus, it can be seen that the tube 310 serves particularly to eliminate or cut out low level noise, and the bias on the tube is set by means of the input bias control resistor 303 in such a way that any noise introduced into the tube 310 could not feed to the peak limiting tube 321. Similarly, it becomes apparent, from what is shown, that when there is signal energy applied to the tube 310 it will function to carry the peak limiting tube 321 negative, so as to cut out the effects of high peaks. The threshold limiting arrangement herein disclosed, for instance, by the tube 310, thus is somewhat of a departure from that disclosed by the Mathes patent referred to, although it is to be understood that the general purpose behind the two arrangements is substantially alike.

Output from the discriminator transformer 326 appears in two separate secondary windings 329 and 331 which are suitably tuned to the two beat frequencies hereinabove mentioned to correspond to the frequencies at which the transmitter transmits white and black, for instance, so that one might tune the secondary winding 329 by means of condenser 333 so that it becomes resonant to a frequency of the order of 1800 cycles, assuming a value as above noted for one extreme beat frequency of the oscillators 129 and 183 respectively.

A suitable damping resistor 335 may be provided across both the secondary coil 329 and the tuning condenser 333. Similarly, with respect to the lower of the two limiting beat frequencies hereinabove assumed as 1000 cycles for the beat between the two oscillators 129 and 183, provision is made for tuning the secondary winding 331 by a condenser 337 across which, where desired, a resistor 339 may be included.

It will be noted that since the beat frequencies selected are absolute values and normally not tending in any way to change, the condensers 333 and 337 may, generally speaking, be of fixed value, although it is readily apparent that where the beat frequencies would change to other values, variable condensers may be used for the condensers 333 and 337.

One terminal of the tuned circuits provided by the secondary 329 and the condenser 333 on the one hand, connects to one cathode 340 of a discriminator tube 341, while one terminal of the other tuned circuit provided by the transformer winding 331 and the condenser 337 connects to the second cathode 342 of the discriminator tube 341. The outer terminals of the tuned circuits are joined together by the conductor 343 and connect to ground 21 by way of the resistor 344, which resistor may be bridged by the by-pass condenser 345.

One anode 347 of the discriminator tube, which may also be of the general type known as the 12H6, where desired, connects preferably directly to ground 21 by way of a conductor 348, while the other anode 349 connects to ground by way of both the resistor 350 and the resistor 344. This second anode element 349 also is connected to supply its output by way of a conductor 351 to a terminal point 352 from which a start-stop relay is controlled. This start-stop relay is not herein specifically shown, but will form the subject matter of a companion application, Serial No. 467,424, filed Nov. 30, 1942.

Energy in conductor 351 is also supplied to a driver-inverter tube 353 by way of a resistor 354

which is connected to the control electrode or grid 355 of the driver-inverter tube. The driver-inverter tube 353 is, for instance, a tube of the double triode type such, for example, as the 12SL7GT, although other similar type tubes might equally well be used.

Output from the first half of the tube including the control electrode 355, the plate or anode 356 and the cathode element 357 is fed by way of conductor 358 and resistor 359 to the control electrode 360 of the second half of the tube comprising a cathode 361 and a plate or anode 362, so that this output is supplied by way of a direct current connection from the first half of the tube to the second half of the tube. Also, a portion of the output of the first half of the tube is fed by way of the conductor 363 to the control electrode 364 of a power output tube which is preferably one of the so-called beam power tubes 365, such as the 12A6 for instance.

The output from the second half of the tube 353 as it appears at the anode or plate element 362 is then fed by way of a conductor 366 to the control electrode 367 of a second power output tube 368 of a characteristic generally similar to the tube 365 as will hereinafter be explained.

The cathodes 357 and 361 of the tube 353 are suitably biased to ground 21 by way of the biasing resistors 370 and 371, for instance, of which the cathode 357 is adjustably tapped at point 372 on the resistor 370.

Connected between the terminals of resistors 370 and 371, remote from ground, is a third resistor 373. The cathode elements 375 and 376 of the tubes 365 and 368 respectively also connect to ground 21 by way of the conductor 377 and the resistor 371 which applies the suitable bias on all the cathodes 361, 375 and 376 relative to ground.

The output or load resistor 379 for the tube half comprising the cathode 357, the control electrode 355 and the anode 356 of the tube 353 connects between the cathode 375 and the control electrode 364 of the tube 365, so that voltage drops appearing across the resistor vary the potential of the control electrode relative to its cathode and control thereby the current flowing in the tube. Similarly, the load resistor 381 is provided for the half of the tube comprising the cathode 361, the control electrode 360 and the anode 362, so that voltage drops appearing across the resistor 381 are transferred to the control electrode 367 of the power output tube 368.

The cathodes 375 and 376 of the tubes 365 and 368 respectively are suitably by-passed to ground 21 with regard to high frequencies by means of the capacity element 383. The screen electrodes 384 and 385 of the tubes 365 and 368 respectively are supplied with suitable bias voltage by way of a connection to the terminal point 386, as indicated. Suitable plate potential for the anode or plate elements 388 and 389 is applied by way of the connection through the printer unit coils 392 and 394 and also the resistors 390 and 391 to the positive potential terminal 396.

The beam forming electrodes 393 and 395 of the tubes 365 and 368 connect to the respective tube cathodes in well known manner. Output energy from the tubes 365 and 368, as it appears across the load resistors, is applied also to actuate the printer coils 392 and 394 of a recorder scanner. The printer coils actuate a presser bar member which is caused to bear upon a recording sheet or strip above which is rotated a suit-

able drum or cylindrical element having, upon its outer periphery, a plurality of helix members which extend for approximately 360°, so that in its rotation the helix traces a plurality of paths across the printer bar element.

The specific arrangement of the printer bar relative to the cylinder or drum and its helix is not herein illustrated. The relationship between a single helix and presser bar has been described fully in Reissue Patent No. 20,152 dated October 27, 1936, granted to Charles J. Young, and also Patent No. 2,215,806, where the arrangement is used for electrolytic recording. In case the arrangement herein disclosed is used for recording with carbon paper or the like upon a record strip, as shown in the Young Reissue Patent No. 20,152, the presser or printer bar is adapted to be moved by means of the actuating coils 392 and 394. In case electrolytic recording is depended upon for producing the record at the receiving points, then it is obvious that the current flowing in the output of the tubes 365 and 368 may be caused to vary the current flowing between the presser bar (then tending to rest continuously upon the record strip or sheet and the helix on the cylinder or drum) and the helix, so that the current flowing through the record sheet is varied. Under such circumstances it is, of course, obvious that the arrangement herein disclosed may be so constituted that the receipt of signals of one frequency may cause current to flow through the record strip, and the receipt of signals of the other frequency may control the interruption of a current.

In the companion case relating to this general arrangement, reference will be made to the form of control provided from the terminal 352 to a start-stop system by which recording is controlled, and also by which the generation of the operating voltages and currents is established and which will include reference to the use of suitable current regulators and the like.

The general arrangement of this present application is particularly directed to the transmitting and the receiving or monitoring equipment, as contrasted with the system by which it is driven and controlled. It will be understood, however, that for complete reference, this application and applicant's specification Serial No. 467,424, filed Nov. 30, 1942, hereinabove mentioned, should be considered in combination with one another for reference to the complete system. In this connection, it is apparent the modifications of this arrangement of the disclosed device, particularly as to the scanning instrumentality, will be evident from a consideration of what has herein been stated.

Having described my invention, what I claim as new and desire to have protected by Letters Patent is:

1. In a signalling system, an oscillation generator, an oscillatory circuit including inductance and capacity elements associated with said oscillation generator, a plurality of cascaded thermionic control tubes for said oscillation generator, means for deriving signalling energy occurring at two predetermined energy levels to represent two different signal transmission conditions, means for supplying said signalling energy to said control tubes, means to control the passage and interruption of current through said control tubes by the signalling energy supplied, said control tubes being in a different condition of conductivity, reactive means in series with one of said control tubes, said reactive means and said last

named control tube being connected in parallel with said oscillatory circuit whereby said generator produces oscillations at two frequencies determined by the periods of current passage in the control tubes at the two said energy levels.

2. In a signalling system, a thermionic tube and an oscillatory circuit including inductance and capacity elements associated with said thermionic tube whereby said tube develops oscillatory energy, a plurality of cascaded thermionic control tubes for the oscillator tube, means for deriving signalling energy occurring at two predetermined signal levels to represent conditions of signal spacing and signal marking, means for supplying said signalling energy to said control tubes, means to control the passage and interruption of current through said control tubes by the signalling energy supplied, said control tubes being in a different condition of conductivity, reactive means in series with one of said control tubes, said reactive means and said last named control tube being connected in parallel with said oscillatory circuit whereby said generator produces oscillations at two frequencies determined by the periods of current passage and interruption in the control tube.

3. In a signalling system, a thermionic oscillation generator, an oscillatory circuit including inductance and capacity elements associated with said oscillation generator, a plurality of thermionic control tubes for said oscillation generator, photo-electric means for deriving signalling energy occurring at two predetermined energy levels to represent conditions of spacing and marking, means for supplying said signalling energy to said control tubes, means to control the passage and interruption of current flow through said control tubes by the signalling energy supplied, and means operating under the control of said control tubes for including and excluding a capacitive impedance in the said oscillatory circuit to vary the frequency thereof between two limiting values determined by the periods of current passage and interruption in the control tubes.

4. In a signalling system, a thermionic oscillator, an oscillatory circuit including inductance and capacity elements associated with said oscillator, a plurality of thermionic control tubes for said oscillator, means for deriving signalling energy occurring at two substantially different signal levels to represent conditions of spacing and marking, capacitive means for supplying said signalling energy to said control tubes, resistance means to control the first of the said control tubes to set the level at which current flow through the said control tubes is passed and interrupted by the signalling energy supplied, and means operating under the control of said control tubes for changing the impedance of the said oscillatory circuit between two limiting values to generate energy from the oscillator at each of two predetermined frequencies determined by the periods of current passage and interruption in the control tubes.

5. A signalling system comprising a light translating means to develop energy at each of a plurality of different signal levels determined by marking and spacing periods, a thermionic oscillator having included therewith an oscillatory circuit comprising inductive and capacitive impedance elements, a plurality of control tubes connected intermediate the light translating means and the said oscillator, capacitive means for energizing the control tubes from the said light translating element to cause said tubes al-

ternatively to pass and interrupt a flow of electrical energy in accordance with the alternate conditions of output from the light translating element, and means responsive to one of the states of current passage and interruption in the said control tubes for changing the oscillatory frequency of the oscillator to one extreme value and for changing the oscillatory frequency of the oscillator to the other extreme value for the opposite condition of current passage and interruption in the control tubes.

6. The circuit claimed in claim 5 comprising, in addition, resistance means for controlling the signal level for each extreme condition of output from the light translating means.

7. The circuit claimed in claim 5 comprising, in addition, a second oscillator of substantially fixed output frequency, means for heterodyning the outputs of each of the oscillators, and means for applying the resultant output signal to a transmission channel.

8. A signalling system comprising a light translating means to develop energy at each of a plurality of different signal levels determined by marking and spacing periods, a thermionic oscillator having included therewith an oscillatory circuit comprising inductance and capacity elements, a plurality of control tubes connected intermediate the light translating means and the said oscillator, capacitive means for energizing the control tubes from the said light translating element to cause said tubes alternatively to pass and interrupt a flow of electrical energy in accordance with the alternate conditions of output from the light translating element, means responsive to one of the states of current passage and interruption in the said control tubes for changing the oscillatory frequency of the oscillator to one extreme value and for changing the oscillatory frequency of the oscillator to the other extreme value for the opposite condition of current passage and interruption in the control tubes, a second thermionic oscillator for developing a substantially constant output, frequency means for combining the outputs of the two said oscillators to produce a resultant beat frequency varying between two limiting values in the audible frequency range, means for supplying such signals to a transmission channel, a plurality of thermionic tubes connected in cascade to receive energy from said transmission channel, said tubes comprising a plurality of diode rectifiers and a plurality of thermionic limiting tubes connected to receive the output energy from said diodes, the said diodes serving to remove low level noise from the signals in the transmission channel and the thermionic limiting tubes serving to eliminate peak noises from the signals in the transmission channel, a discriminating network connected with the output of the peak limiting tubes for detecting the signal energy at the two selected frequencies, and means for recording the detected energy.

9. A signalling system comprising a light translating means providing a source of signal energy at levels defined by two limit values, a first thermionic control tube, a pair of diodes, and a second thermionic control tube, means for applying the signal energy to the first control tube and simultaneously to one of the diodes so that the tubes conduct in opposite senses, means for controlling the second diode from the first con-

trol tube so that each of said tubes is simultaneously conducting, means for controlling the second control tube by the second diode so that the second control tube is non-conducting during conducting periods of the second diode, an oscillator, a capacity element connected in the oscillatory circuit of said oscillator, and means provided by said second control tube for including the said capacity element in the oscillatory circuit at time periods when said control tube is operative and excluding the capacity element at time periods when the second tube is inoperative whereby the oscillatory frequency is alternatively changed between two limit values.

10. The circuit claimed in claim 9 comprising, in addition, resistance means for controlling the signal level for each extreme condition of output from the light translating means.

11. The circuit claimed in claim 9 comprising, in addition, a second oscillator of substantially fixed output frequency, means for heterodyning the outputs of each of the oscillators, and means for applying the resultant output signal to a transmission channel.

12. A signalling system comprising a source of signal energy, a first thermionic control tube, a pair of diodes, and a second thermionic control tube, means for applying the signal energy to the first control tube and simultaneously to one of the diodes so that the tubes conduct in opposite senses, means for controlling the second diode from the first control tube so that each of said tubes is simultaneously conducting, means for controlling the second control tube by the second diode so that the second control tube is non-conducting during conducting periods of the second diode, an oscillator having an oscillatory circuit including impedance elements, and means provided by said second control tube for placing the impedance of the oscillatory circuit at one extreme value at time periods when said control tube is operative and placing the impedance of the oscillatory circuit at another extreme value at time periods when the second tube is inoperative whereby the oscillatory frequency is alternatively changed between two limit values.

13. A signalling system comprising a scanning element for generating signal energy at levels varying between two limit values, a plurality of thermionic control tubes and a plurality of rectifying tubes, capacitive means for applying the signal energy to one of the said control tubes and simultaneously to one of the said rectifiers so that the tubes conduct in opposite senses, means for controlling the other of said rectifying tubes from the last named control tube so that each of said tubes is simultaneously conducting, means for controlling the second control tube by the second rectifying tube so that the second control tube is non-conducting during conducting periods of the second rectifying tube, a vacuum tube oscillator having an oscillatory circuit including inductive and capacitive elements, and means provided by said second control tube for varying the impedance of the oscillatory circuit between two predetermined values at time periods when said control tube is operative and at time periods when the second tube is inoperative whereby the oscillatory frequency is alternatively changed between two limit values.

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