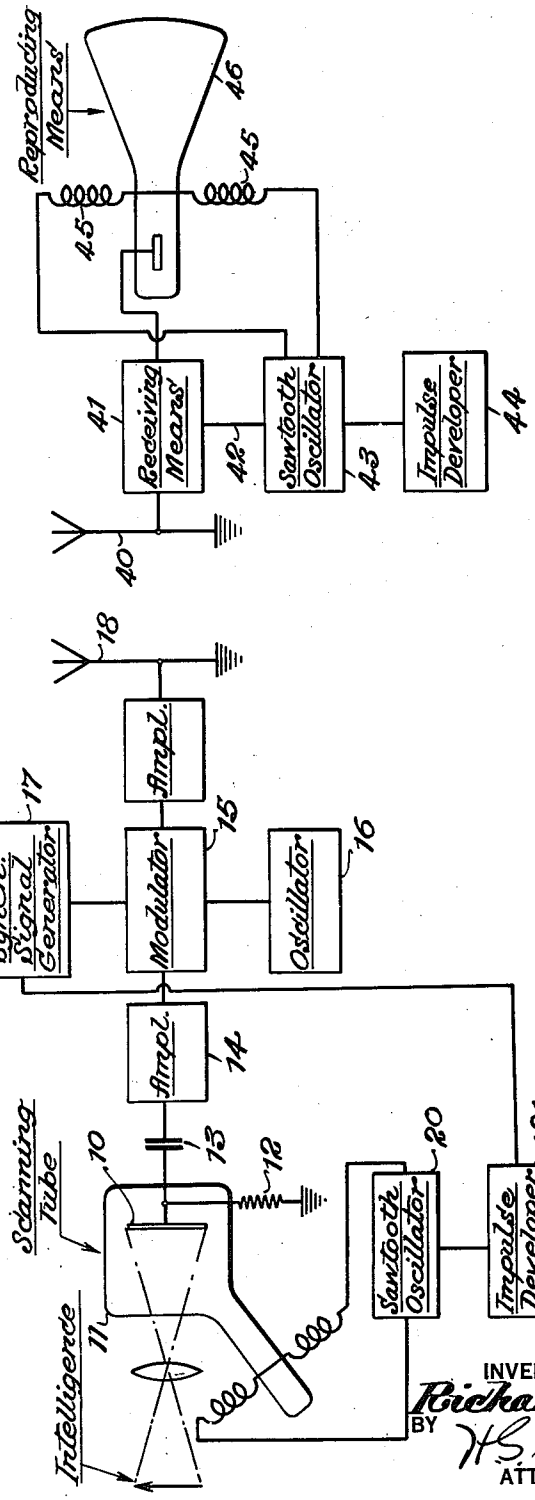
June 11, 1946. R. E. MATHES 2,402,067

DEVICE FOR SECRET COMMUNICATION

Filed Oct. 30, 1941 2 Sheets-Sheet 1

Fig. 1.



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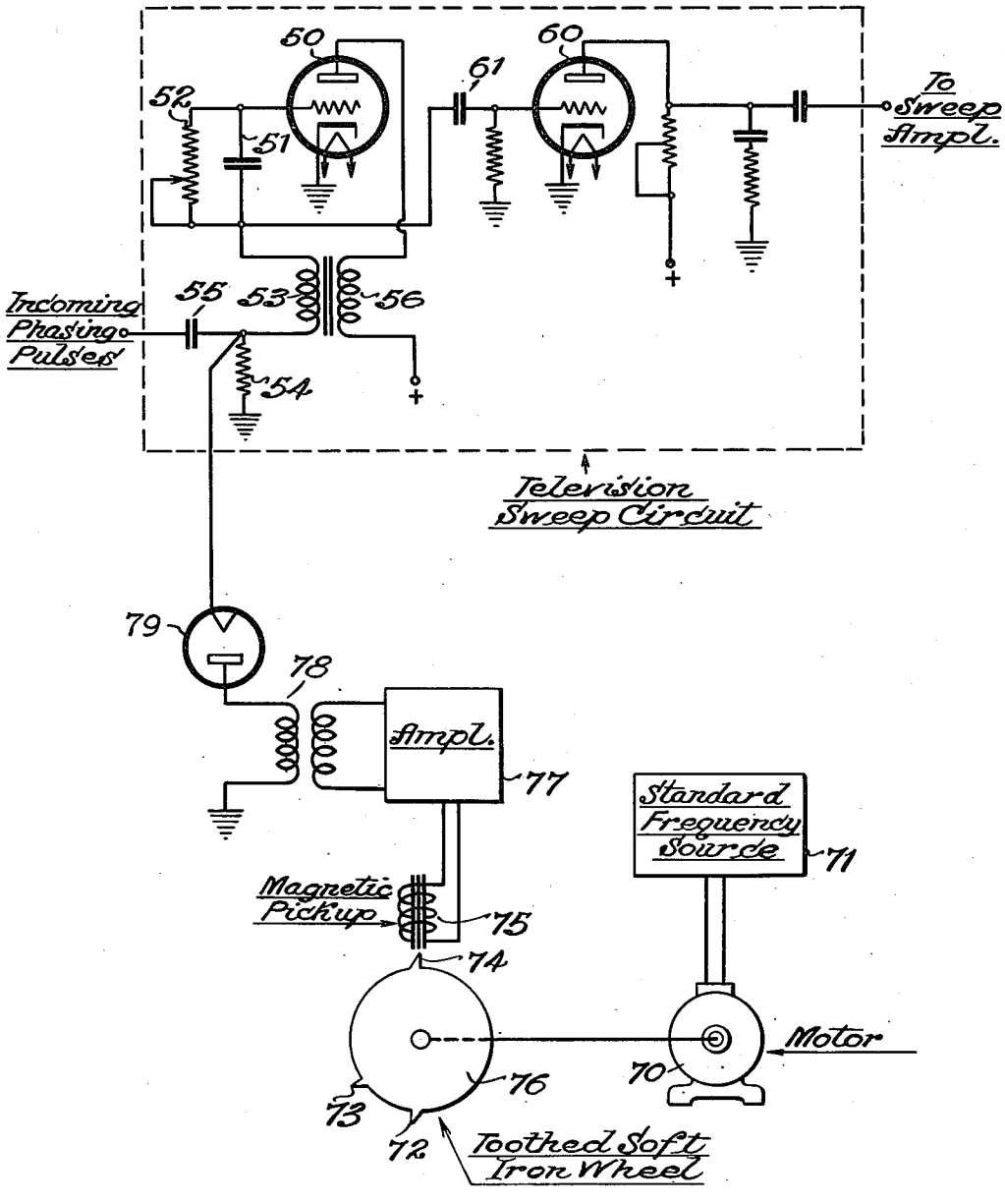
Filed Oct. 30, 1941 2 Sheets-Sheet 2

Fig. 2.



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DEVICE FOR SECRET COMMUNICATION

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3 Claims. (Cl. 178—6.8)

1

My invention relates in general to systems for the transmission of intelligence at a distance, and more particularly to a high speed facsimile system for secret transmission.

Methods for the secret transmission of intelligence have been proposed in the prior art heretofore known, but have suffered from the fact that these have either been critical or impractical in a number of cases. Accordingly, it is one of the objects of my invention to provide an arrangement for the secret transmission and reception of high speed facsimile which will not suffer from these disadvantages.

Another objection of the prior art has been the fact that in a number of instances secret transmissions have been suggested in which a frequency "wobulation" has been utilized, that is to say, that the frequency of the transmitted carrier has been varied in accordance with some predetermined pattern and, at the receiver, the tuning of the device has been accomplished by means of changing the constants of the tuned circuits in the receiver in accordance with this pattern. In systems of this nature it has been found that it has been very difficult to keep the transmitter and the receiver in synchronism, and that the constant changing of the tuning was undesirable. Accordingly, it is another of the objects of my invention to provide an arrangement in which secret transmission and reception of intelligence may be accomplished without changing the frequency of the transmitted carrier wave.

The art of facsimile transmission and reception has assumed an increasing importance in military matters, particularly for the transmission of maps and the like from aeroplanes, as well as the transmission of maps to differing military headquarters. Of necessity, therefore, the device must be very accurate in operation. Accordingly, it is another of the objects of my invention to provide a facsimile system for the secret transmission of facsimiles, and which will be particularly adaptable to military needs.

In general, my invention contemplates a facsimile system set up on the basis of general television technique as it is practiced today. For instance, the intelligence to be transmitted may be impressed onto the photo-electric cathode of a cathode ray tube and scanning may be accomplished by normal means. At the receiver the image is reconverted into an optical image by means of the normal television receiver utilizing a reproducing device such, for instance, as a "Kinescope." Circuits are known for generating serrated or sawtooth wave forms which are used

2

to deflect the cathode ray beam in a normal scanning tube back and forth across the photo-electric mosaic thereof, and circuits are known for the generation of such a wave form at the receiver synchronously with that at the transmitter so that the cathode ray beam in the receiver moves synchronously with that of the transmitter. Such circuits per se are well known to the prior art, and since well known forms are usable for this purpose, and no particular form of sawtooth oscillator is necessary, I am not limited to the use of any particular form thereof. Reference may be had to the article entitled "An Experimental television system" beginning on page 253 of the publication "Television," published July, 1936, by the RCA Institutes Technical Press. In accordance with my invention there is provided at the transmitter and receiver a pulse which is varied in time and which is impressed onto a control element of the sawtooth wave generator so that scansion at the transmitter and receiver varies synchronously from time to time.

My invention will be understood best by reference to the drawings, in which:

Fig. 1 shows schematically a system in accordance with the invention.

Fig. 2 shows an embodiment of my invention for controlling the scansion rate.

Referring to Fig. 1, there is shown a schematic representation of my invention. Intelligence to be transmitted is impressed onto the photo-electric mosaic 10 of a scanning tube 11, the latter which may be such as an "Iconoscope" tube or the like, and video signals are developed across the grounded resistor 12. The video signals are then fed through coupling condenser 13 to amplifying means 14 to a modulator 15, the latter being energized simultaneously by oscillating means 16 by means of which the carrier wave is developed. Also, a synchronizing signal generator 17 is illustrated which also modulates the carrier wave. The modulated signal then is fed through appropriate amplifying means to radiating means 18.

Scansion in the "Iconoscope" tube is accomplished by developing a cathode ray beam and moving the beam back and forth across the photo-electric mosaic. Such beams are well known and will not be described in detail here. The deflection of the beam may be accomplished either electrostatically or electromagnetically. In the illustrated arrangement the deflection is accomplished electromagnetically and for purposes of convenience only one pair of the deflecting coil pairs is illustrated, this being sufficient to move

the beam in one co-ordinate of motion. The coils are energized by the waves developed in a sawtooth wave generator 20, and according to this invention an additional pulse which may control the time of generation of the sawtooth wave is developed in the impulse generator 21 and is impressed onto the sawtooth wave generator. Since the impulse is not necessarily regular, but may be developed at varying intervals, it will be appreciated that scansion will take place at differing intervals. It will be appreciated also that although means have been illustrated for deflecting the beam in one co-ordinate of motion, this has been done for purposes of simplicity and the means for deflecting the beam in the other co-ordinate may have impressed thereon an additional impulse for changing the scansion time in that co-ordinate of motion also, although this need not necessarily be done.

At the receiver the modulated carrier wave is picked up on the antenna 40 and is impressed onto receiving means 41. The latter has been identified by the term receiving means since, in the normal receiver, the sawtooth oscillator forms a part of the receiver as does the reproducing tube, however for purposes of clarity these elements have been shown separately here. Synchronizing signals, after being separated from the video signals within the receiving means 41, are impressed onto the sawtooth oscillator 43 by means of conducting means 42. Also impressed onto the sawtooth oscillator are the impulses developed within the impulse developer 44. These impulses, of themselves irregularly timed, should cause the wave driven through the deflecting coils 45 of the reproducing tube 46 to cause the cathode ray beam to scan in one co-ordinate of its motion irregularly, but nevertheless synchronously with the scanning beam at the transmitter. Since the scansion will be irregular, it will be impossible to reproduce the video signals in a normally operating receiver, and in order to reproduce them in any intelligible fashion the scanning beam at both the transmitter and receiver would have to operate synchronously. Hence, the transmitted material would be secret except to those receivers whose scanning beam operated in the exact irregularity as that of the transmitter. Again, for purposes of simplicity, only means for deflecting the beam in one co-ordinate of its motion has been illustrated at the receiver. Hence appropriate means might be provided for causing irregular scansions in the other co-ordinate of motion which might be utilized also, as in the case of the transmitter.

Referring to Fig. 2, there is shown one form of apparatus for developing waves which, when impressed onto the deflecting means of the scanning or reproducing tube, will cause irregular scansion. The sawtooth wave generator illustrated in this figure is known as the vertical sweep oscillator of Fig. 21 of the article entitled "An experimental television system," by Holmes, Carlson and Tolson, beginning on page 279 of the publication "Television," published July 1936 by the RCA Institutes Technical Press, and as such comprises a type of oscillator known to the prior art. In this oscillator there is provided a thermionic tube 50 having an anode, cathode and control electrode. The control electrode is connected back to the cathode through a time constant circuit comprising a condenser 51 and a variable resistance 52 connected in parallel therewith which are connected serially with an inductance 53 and a resistor 54. A coupling condenser 55 allows synchronizing pulses to be impressed onto the control electrode-cathode circuit of the tube. The anode of the tube is connected back to the cathode through an inductance 56 and an anode energizing source (not shown) having the positive side thereof indicated by the terminal marked +. The inductance 56 is coupled to the inductance 53 so as to feed back a portion of the energy in the anode-cathode circuit of the tube to the control electrode-cathode circuit of the tube. The operation of the device is as follows:

Assuming that there is no charge on condenser 51, current will flow in the anode circuit of the tube 50 and a portion of this energy will be fed back to the control electrode of the tube in such a manner as to make the control electrode more positive. This will cause increase in anode current with consequent increase in control grid potential until grid current is drawn and condenser 51 will be charged to the extent that it will block the current flow to the anode. This current then will leak off across resistor 52 and will do this in accordance with the value of the resistance and the condenser. When the charge has leaked away sufficiently, or when the potential of the control grid has been raised sufficiently by the receipt of a synchronizing pulse impressed thereon through condenser 55, anode current will commence to flow again and the cycle will be repeated. The sawtooth shaped waves then may be impressed onto the control grid of a thermionic tube 60 which has the control grid thereof connected to the time constant circuit 51, 52 through condenser 61. Since these circuits are well known no further explanation should be necessary, it being well understood that eventually the impulses are utilized to control scansion of a cathode ray beam.

In accordance with one embodiment of my invention, a motor 70 which may be a synchronous motor may be supplie by energy from a standard frequency source 71. Connected to the shaft of the motor is a toothed wheel, having the teeth thereon irregularly spaced around the periphery of the wheel. Three teeth 72, 73, 74 are illustrated. Positioned adjacent the periphery of the wheel is a magnetic pickup member 75 and an impulse is developed in the winding thereof each time a tooth of the wheel 76 passes through the magnetic field of the magnetic pickup. The electrical impulses developed in the pickup may be amplified by an amplifier 77, the latter having the output thereof coupled to an inductive member 78. The member 78 is connected to the anode of a diode 79 and the latter is coupled to the control grid electrode of the tube 50 in such a manner as to increase the potential of the grid of the tube relatively to the cathode thereof whenever a pulse is developed in the magnetic pickup. The operation of the device at the receiver is as follows.

The placement of the teeth on the wheel 76 and the speed of the wheel are so designed that the pulses developed within the magnetic pickup, when generated, will be impressed on the control grid of the tube 50 a certain small time interval before the synchronizing pulse from the incoming signal is impressed thereon. Thus the sweep of the cathode ray beam will be advanced in phase a certain amount at every occurrence of the local pulse. The transmitter has a similar device to advance the sweep at that location. If the wheels at the transmitter and the receiver are coded alike and operate in synchronism, the result will

be perfect reception by the equipment so coded and equipped, whereas other receivers not so coded will not receive and record intelligible signals. The amount of the sweep advancement must be set so that the received pulse from the transmitter will not of itself correct the receiver sweep. The stronger generated local pulse should correct the receiver sweep to itself.

Other methods than the pulse wheel may, of course, be used, the pulse wheel merely representing one embodiment of my invention. For example, a complex beat frequency between several oscillators might be used to produce periodic sharp pulses. Relaxation oscillators or the like might be used to produce periodic sharp pulses.

It will be appreciated that my invention contemplates the provision of effective secrecy through a predetermined co-operative manner of shifting the phase of a scansion operation at intervals. The invention might be applied just as well to the art of television as to the art of facsimile. Nor is it absolutely necessary that an "Iconoscope" type of scansion and "Kinescope" type of reproduction be used. Revolving drum facsimile scanners which utilize motors which can be made to "slip" a predetermined amount by the interruption of current supply to the driving motor are known, and the idea could be well utilized and applied to this type of scansion and reproduction, although it is believed that the described embodiment is the preferable embodiment.

Accordingly, I claim all of the departures from

the particular showing of this invention which fall fairly within the spirit and scope of the invention as defined in the hereinafter appended claims.

What I claim is:

1. A reproducer for reproducing intelligence received in the form of recurring trains of signals having unequal intervals between trains comprising cathode ray reproducing means for converting electrical signals into visual representations, means for deflecting the cathode ray in said cathode ray reproducing means, oscillating means for energizing the means for deflecting the cathode ray, and means including an electromagnetic induction device for controlling the time of operation of said oscillating means whereby said oscillating waves recur at unequally spaced intervals.

2. Apparatus in accordance with claim 1, wherein the means for controlling the time of operation of said oscillating means comprises an electromagnetic pulse generator having means for developing variably timed pulses which are impressed onto said oscillating means.

3. Apparatus in accordance with claim 1, wherein the electromagnetic induction device comprises an electromagnetic pickup unit having at least a portion of the output thereof impressed onto said oscillating means, a toothed magnetic member operatively associated with said pickup means, and means for driving said toothed member whereby a pulse is developed each time a tooth of the member passes said pickup.

RICHARD E. MATHES.