

Nov. 10, 1942.

J. W. COX

2,301,375

FACSIMILE PHOTO TRANSMISSION AND RECEPTION

Filed Nov. 7, 1940

2 Sheets-Sheet 1

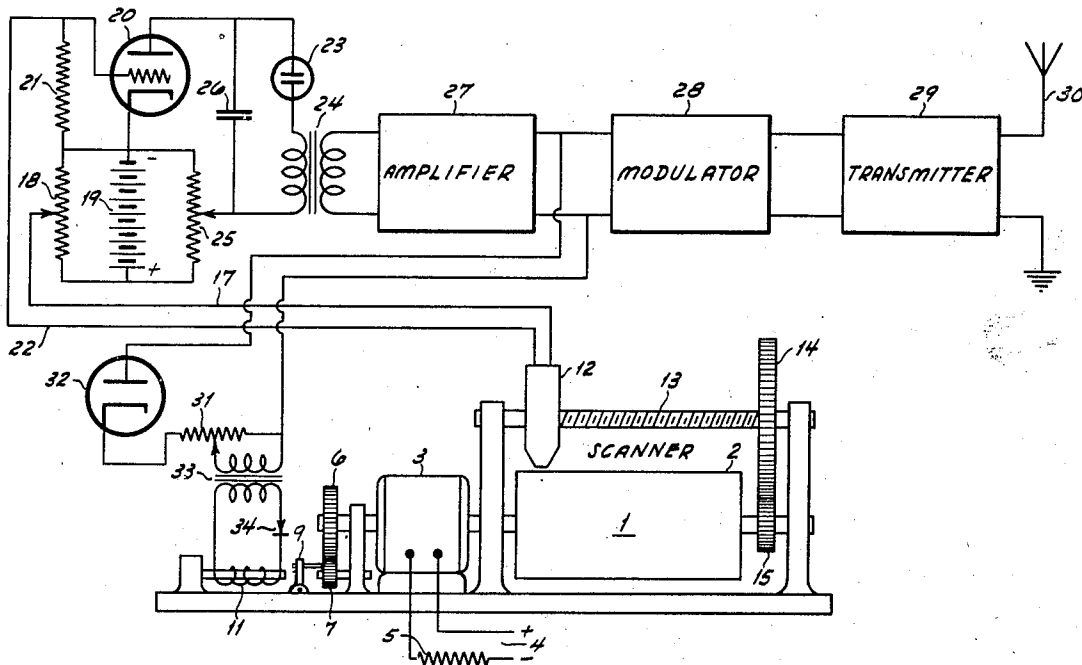


Fig. 1

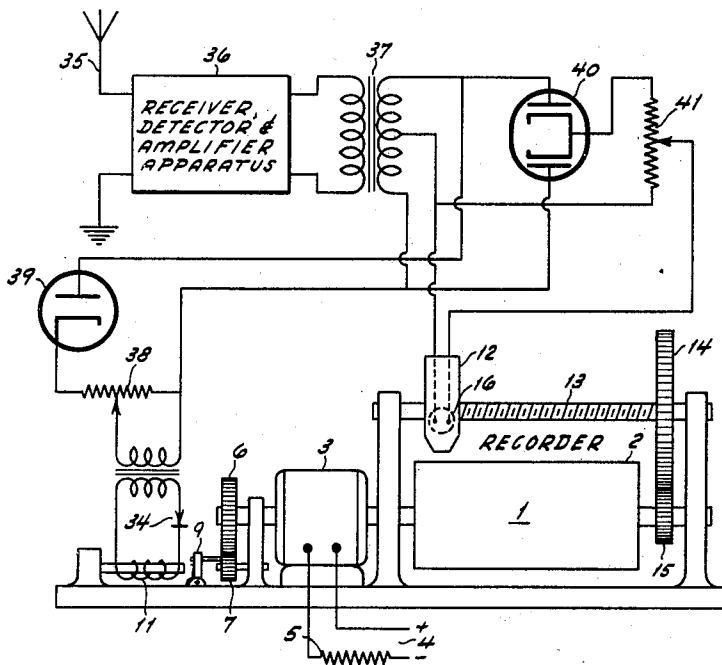


Fig. 2

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2 Sheets-Sheet 2

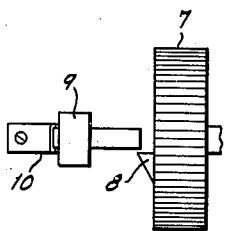


Fig. 3

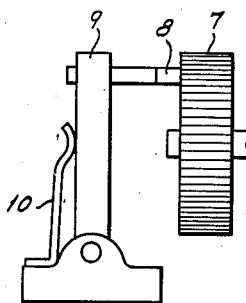
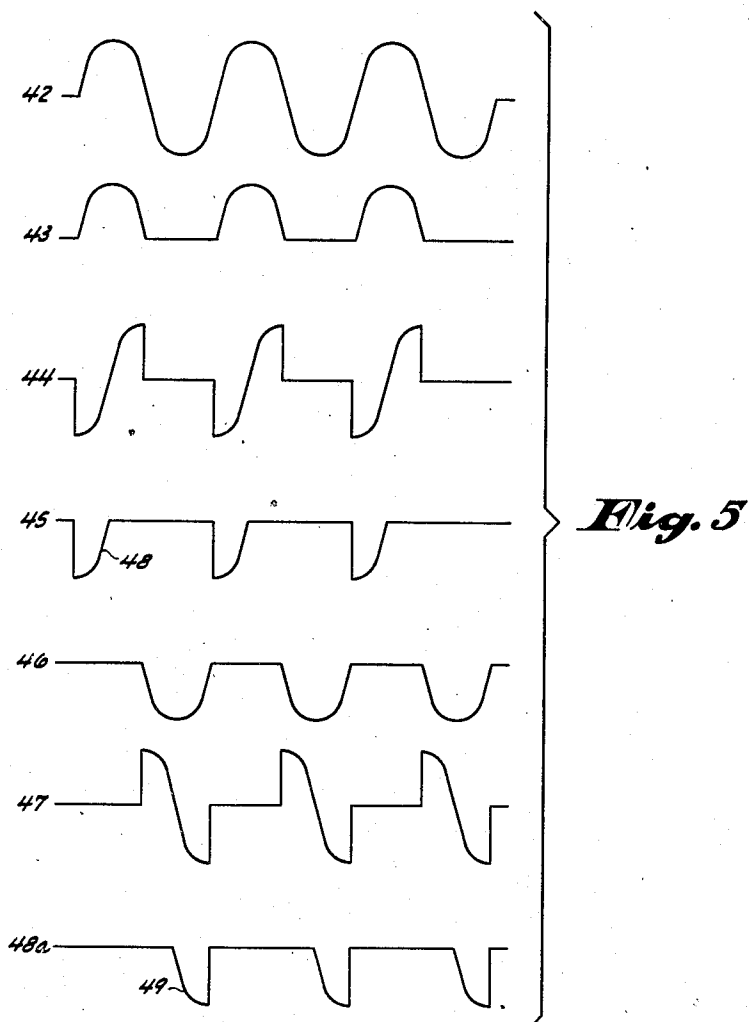


Fig. 4



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FACSIMILE PHOTO TRANSMISSION AND
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8 Claims. (Cl. 178-6.7)

This invention relates to the transmission and reception of facsimile and analogous signals.

An object of this invention is to transmit signals having a frequency varying with the shading of the subject and to move the drum, or other scanning and recording surface, relatively past the analyzing member at a rate that varies with the frequency of the signal.

Another object is to accomplish the result set forth in the previous object by rectifying the alternating signals and stepping the drum or other surface relatively past the analyzing member a given amount for each rectified cycle.

Another object is to eliminate synchronizing units at the transmitter and receiver by operating the transmission scanner and the receiving recorder surfaces at rates varying with the shading of the subject, whereby proper shading is produced by controlling the time of recording the signal pulses.

Other objects will appear in the following description, reference being had to the drawings, in which:

Fig. 1 is an illustration of the transmitting apparatus.

Fig. 2 is an illustration of the receiving apparatus.

Fig. 3 is a plan of the pinion and release catch of the scanner and recording drum.

Fig. 4 is an elevation of the detent and pinion shown in Fig. 3.

Fig. 5 is a series of graphs used in explaining the operation of the invention.

In the usual facsimile apparatus, constant speed units with appropriate controls are used at the transmitter and receiver to keep the scanner and recorder operating at proportional speeds. While accurate frequency units have been developed in the prior art, it is an advantage to omit such units from the system, because of their original and maintenance costs. In my facsimile system these speeds units are not required.

Referring to Fig. 1 of the drawings, the scanner 1 at the transmitter may be of any type for producing relative motion between the pick-up and the picture or subject to be transmitted, but I have illustrated it, by way of example, as consisting of a drum 2 rotated by motor 3, energized from direct current mains 4. This motor has a suitable resistance 5, so that it can be stopped with the current on without injury to the windings. The motor can either be geared to the drum or connected directly thereto. For simplicity of illustration I have shown the latter.

The motor has a gear 6 meshing with a pinion 7, which controls its rotation. The pinion 7, shown enlarged in Figs. 3 and 4, has a catch 8 engaging a pivoted dog 9, urged by spring 10 into engagement with the catch 8. The dog 9 is positioned adjacent an electric magnet 11, so that it can be momentarily moved away from the catch against the tension of spring 10, when the magnet is energized.

The scanner has a pick-up 12 containing a suitable photo-electric cell and a light source for illuminating the element of the subject on the drum directly beneath the pick-up. Since the photocell and the illuminating element are well known in the art, they have not been illustrated.

The pick-up 12 is moved axially of the drum by the usual threaded shaft 13, rotated by gear 14 meshing with a pinion 15 on the drum shaft. The gears in the scanner may have any desired pitch, as the invention is not limited to any line advance or circumferential speed of the drum. However, by way of example only, it will be assumed that when the dog 9 disengages the catch 8 so that the pinion can make a revolution, the drum 2 will be moved circumferentially one-fiftieth of an inch and the pick-up 12 will move to the right one-fiftieth of an inch for each complete revolution of the drum. That is, the line advance will be one-fiftieth of an inch.

The scanning device of the recorder will be the same as that shown at the transmitter, except that the element 12, instead of having a photo-electric cell for conversion of varying illumination into electric currents, will have a device for converting current into either illumination or mechanical motion to produce a record. This may be produced in any of the well-known ways, but merely by way of example it is assumed that the element 12 at the receiver contains a neon or other suitable lamp 16 for converting the signal pulses into illumination and that the drum supports a light sensitive surface for producing a picture in a suitable dark room.

The pick-up 12 at the transmitter is adjustably connected by conductor 17 to a potentiometer resistance 18 joined to the terminals of battery or other source of voltage 19. While the voltage variations produced by the photocell of the pick-up 12 can be used either to reduce or to increase the potential applied to the grid of the tube, I have illustrated it, by way of example, as increasing the potential. The negative terminal of the battery 19 is thus connected to the cathode of this tube. The cathode of tube 20 is also connected through a suitable resistance 21

to the grid, to which the remaining terminal 22 of the pick-up is connected.

The plate of tube 20 is connected through a neon tube 23 and the primary of transformer 24 to a potentiometer resistance 25 connected around battery 19. This connection preferably is made adjustable, as shown. A condenser 26 is connected across the neon tube and the primary of transformer 24 for producing oscillations, though it could be connected in other ways to the elements illustrated without materially changing its operation.

The secondary of transformer 24 is connected to suitable amplifier stages 27 and this is connected to any type of modulator 28 for modulating the radio frequency carrier produced in transmitting apparatus 29 having an antenna 30. The amplifier, modulator and transmitting apparatus may be of any type and hence are not illustrated in detail, since they are well known in the art.

The amplifier 27 also has connected across its output terminals a load resistance 31 and a half-wave rectifier 32. To produce momentary energization of the magnet 11, a transformer 33 and rectifier 34, like rectifier 32 but illustrated diagrammatically, are used to energize magnet 11. By connecting the coil 11 through the rectifier 34 to the secondary of the transformer, it is energized only by a pulse induced at the beginning of the signal. This permits the dog to return soon after the pinion 7 starts its rotation. Of course, the pulse induced in the secondary may be amplified up to any desired value for operating the magnet.

The receiving antenna 35 is connected to receiving, amplifying and detecting apparatus 36 of any well-known form and the audio alternating output of the receiving apparatus is fed into transformer 37. The primary of this transformer has connected across its terminals a load resistance 38 and a half-wave rectifier 39. It has also connected across its terminals a full-wave rectifier 40 and a load resistance 41. A single-wave rectifier may also be used, if desired. The neon lamp 16 is adjustably connected across resistance 41.

The operation of my invention is as follows:

The element of the subject on the drum 2 being scanned by the pick-up 12 in Fig. 1, under the values previously assumed, would be a square with sides of one-fiftieth of an inch. The light reflected from the square is converted into electric current by the pick-up 12. This will produce a certain positive potential across the input of vacuum tube 20, producing a given mutual conductance in the tube and causing condenser 26 to charge at a certain rate. When this condenser is charged to the point where it can cause neon tube 23 to strike, the condenser will discharge, after which the neon tube will cease to conduct current due to the reduction of voltage across its terminals by the drop in the potentiometer resistance 25 produced by the charging current of the condenser as it commences to recharge. The shading on the elemental square of the subject will therefore produce a certain frequency.

The first cycle of the alternating current produced by the condenser 26 and neon tube 23, after proper amplification by amplifiers 27, is rectified by half-wave rectifier 32 and a pulse is induced in the secondary of transformer 33 at the start of the rectified half-cycle. This pulse energizes magnet 11 and releases dog 9. This

permits the motor 3 to rotate the drum 2 one-fiftieth of an inch, whereupon the dog 9 re-engages the catch 8 and stops the movement of the motor and drum. The speed of the motor is such that the pinion makes a revolution before the completion of a cycle of the highest frequency that can be generated in scanning the subject. The pinion, therefore, is always ready to be released at the beginning of each cycle.

The rotation of the drum 2 one-fiftieth of an inch, in the example given, brings the next element under the pick-up 12, which, it will be assumed, has an increased shade. This will produce less potential on the grid of vacuum tube 20 and the time-period of the oscillations of condenser 26 and neon tube 23 will be increased; that is, the frequency will be diminished and the magnet 11 is re-energized after a greater interval of time. This moves the drum another one-fiftieth of an inch by the motor 3, upon momentary release of the catch from the dog 9, bringing the next element under the pick-up, which may be assumed to have a still greater shading. This will produce a still lower frequency having a greater periodic time, which will cause the drum to be stepped another element after a greater period of time.

Thus, the drum at the transmitter is stepped along one element at a time and the time between the individual steps of the drum depends upon the shading of the element beneath the pick-up.

The frequency generated by the condenser 26 and neon tube 23 is used to modulate the transmitter 29 and the modulated radio current is radiated by the antenna 30. The wave is received at the distance receiving station and amplified and the audio frequency is extracted. The apparatus at the recorder is like that at the transmitter and therefore the recorder drum is stepped along in timed relation with the drum at the transmitter. The full-wave rectifier 40 passes the rectified signal pulses to the neon tube 16 and produces illumination for affecting the light sensitive surface on the drum. The time that an element is under the neon lamp is proportional to the shading of the element being scanned at the transmitter and hence the shading produced on the sensitive film, when developed, is the same as, or proportional to that of the element scanned at the transmitter.

Since the time of current flow per cycle in the neon light also varies with the frequency of the modulating current, this also aids in varying the shades at the recorder.

Since the dog 9 is tripped only once each full cycle of the signal frequency, the action may take place at the end of the signal cycle as well as at the beginning. An analysis of the graphs in Fig. 5 shows how this may be easily accomplished. Graph 42 of Fig. 5 indicates the signal frequency produced by the oscillator and transmitted to the receiver. Graph 43 indicates the E. M. F. in resistance 31 if the positive half waves are utilized after rectification. These half waves induce in the secondary of transformer 33 an E. M. F. of the form of graph 44. Graph 45 indicates the form of the E. M. F. after rectification at 34, assuming that the negative half wave is utilized.

By reversing the rectifier 32 so as to utilize the negative half waves of graph 42, a voltage may be produced in resistance 31, as indicated by graph 46. Graph 47 will then indicate the E. M. F. induced in the secondary of transformer 33, while graph 48a will indicate the

rectified E. M. F. in coil 11. One thus has the choice of a pulse 48 at the beginning of a cycle of the signal, or a pulse 49 at the termination of such cycle. One also could use the positive half cycles of graph 44 and the positive half cycles of the graph 47. Both of these would be intermediate the half cycles in respect to phase.

It is practical to adjust the speed of the motor 3 so that the step by step movement of the pinion 7 and drum 2 will be substantially instantaneous if the magnet 11 is so designed that it will attract or hold the armature away from catch 8 only at the peak voltage. The current in the photo-electric cell 12 will then be produced when the drum 2 is stationary, or substantially so.

Various other ways may be devised to cause the pinion 7 to make substantially an instantaneous revolution once each signal cycle.

I have illustrated a simple mechanical catch for releasing the drum, merely to simplify the disclosure. This may be modified in various ways without departing from the spirit of the invention.

Having described my invention, what I claim is:

1. In facsimile and picture scanners, an optical unit having means for producing a light beam, means for causing relative movement between the subject and said beam to bring the elements of the subject successively thereinto, and means for causing said movement to be intermittent with periods of rest varying with the density of the elements passing into said beam.

2. In facsimile and picture scanners, an optical unit having means for producing a light beam, means for causing relative movement between the subject and said beam to bring the elements of the subject successively thereinto, and means for causing said movement to be intermittent with constant periods of movement and periods of rest varying with the density of the elements passing into said beam.

3. In facsimile and picture scanners, a support for the subject being scanned, an optical unit having means for projecting a light beam onto said subject, means for producing relative movement between the support and the beam to bring the elements of the subject successively thereinto, means for producing alternating current of frequency varying with the intensity of the light leaving the elements when in said beam and means for stopping said movement during each cycle of said frequency.

4. In facsimile and picture scanners, a support for the subject being scanned, an optical unit having means for projecting a light beam onto said subject, means for producing relative movement between the support and the beam to bring the elements of the subject successively thereinto, means for producing alternating current of frequency varying with the intensity of the light

leaving the elements when in said beam and means for stopping said movement during the greater part of the time period of each cycle of said frequency.

5. In facsimile and picture scanners, a support for the subject being scanned, an optical unit having means for projecting a light beam onto said subject, means for producing relative movement between the support and the beam to bring the elements of the subject successively thereinto, means for producing alternating current of frequency varying with the intensity of the light leaving the elements when in said beam, means for stopping said movement during each cycle of said frequency and means for translating the last-mentioned light beam into electrical potentials.

6. In facsimile and picture scanners, a support for the subject being scanned, an optical unit having means for projecting a light beam onto said subject, means for producing relative movement between the support and the beam to bring the elements of the subject successively thereinto, means for producing alternating current of frequency varying with the intensity of the light leaving the elements when in said beam, means for stopping said movement during each cycle of said frequency and means for producing electrical potentials varying with the intensity of the last-mentioned light beam.

7. In facsimile and picture transmission, an optical unit, means for producing intermittent relative movement between the subject and the optical unit, the period of immobility varying with the intensity of the light from said unit leaving said subject, means for producing an alternating current having a cycle for each cycle of said intermittent movement, a recorder having a support for a light sensitive surface, means for projecting a light beam onto said surface, means for producing relative movement of said support and said beam and means for stopping the movement of said support during the greater part of each cycle of said frequency.

8. In facsimile and picture transmission, an optical unit, means for producing intermittent relative movement between the subject and the optical unit, the period of immobility varying with the intensity of the light from said unit leaving said subject, means for producing an alternating current having a cycle for each cycle of said intermittent movement, a recorder having a support for a light sensitive surface, means for projecting a light beam of constant intensity onto said surface, means for producing relative movement of said support and said beam and means for stopping the movement of said support during the greater part of each cycle of said frequency.

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