March 21, 1933. H. R. BUTLER ET AL 1,902,486

PICTURE TRANSMISSION

Filed Oct. 31, 1930

Fig. 1.

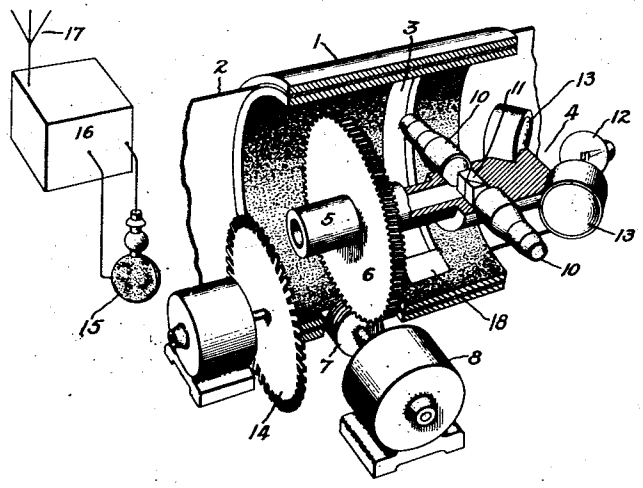
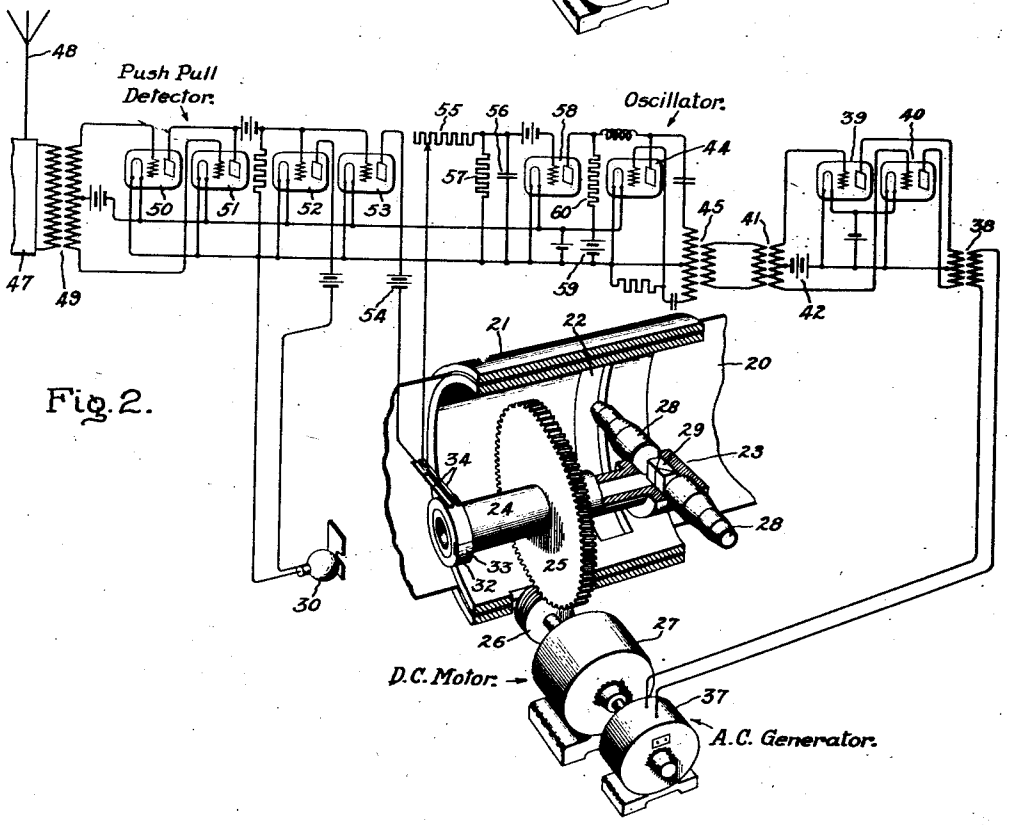


Fig. 2.



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Patented Mar. 21, 1933

1,902,486

UNITED STATES PATENT OFFICE

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PICTURE TRANSMISSION

Application filed October 31, 1930. Serial No. 492,535.

Our invention relates to the transmission of pictures. Certain forms of picture transmission devices heretofore employed have included at the sending and receiving stations devices which insured a fair degree of synchronism but required the constant presence of an operator at the receiving station to make such speed correction from time to time as was necessary to prevent undue distortion of the received picture. Other forms of such apparatus involve the use of devices of greater refinement and accordingly entailing greater expense at the sending and receiving stations which devices operate with such a high degree of synchronism that no correction is necessary over relatively long periods of use. One object of our invention is to provide picture transmission apparatus having improved means for continuously and automatically correcting any lack or synchronism between corresponding parts at the two stations. Another object is to provide improved means for this purpose which is entirely electrical in operation, and a further object is the provision of means for this purpose which is inexpensive to manufacture.

We have chosen to illustrate our invention as applied to apparatus for the transmission of facsimiles by radio of the type disclosed and claimed in the Alexanderson Patent 1,792,264, February 10, 1931, and assigned to the same assignee as the present application. It is to be understood however that our invention is applicable also to various other forms of picture transmission apparatus and is independent of whether the signal impulses are transmitted by radio, wire or other means. We employ the term "picture" throughout the description and claims in its broadest sense, including by it pictures in color, half tones, facsimiles, photographs, etc. or even actual views as distinguished from pictures thereof.

Our invention will be better understood from the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

Referring to the drawing, Fig. 1 represents a facsimile transmitting apparatus and Fig. 2 represents apparatus for receiving the facsimile transmitted from the apparatus shown in Fig. 1. The transmitting apparatus which is similar to that disclosed in the above mentioned Alexanderson patent comprises an arcuate holder 1 for a paper 2 containing the facsimile to be transmitted. The inner portion of the holder 1 is provided with the slot 3 through which the paper 2 is exposed while it is being drawn with a steady motion in an axial direction. Scanning of the paper 2 is effected by the rotatably mounted assembly 4 comprising in part a hollow shaft 5 upon which is mounted the worm gear 6 meshing with the worm 7 which is driven at a uniform speed by the motor 8. Shaft 5 supports two diametrically opposite lens systems 10 between which is the prism 11 for reflecting light therefrom through the hollow shaft 5. The portion of the paper passing the slot 3 is suitably illuminated by the lamp 12 whose rays are concentrated on the paper by the lenses 13 which are rotatably secured to the shaft 5. Opposite the ends of the shaft 5 is the separate motor driven chopper 14 and beyond the chopper is the photoelectric cell 15 which is connected with a suitable radio transmitter 16 shown having the antenna 17.

As the picture is scanned by the rotation of the assembly 4 impulses are transmitted by radio from the transmitter 16 which may be constructed to produce impulses corresponding either to the scanning of dark portions of the picture or light portions thereof. At the end of each scanning line the lens system 10 sweeps over a portion of the paper holder 1 at the end of the slot 3. In the present case the apparatus is constructed to transmit impulses in accordance with black portions of the picture and the interior of the holder 1 is painted a dull black, except for white areas one of which is shown at 18 at each end of slot 3, so that at the end of each scanning line a framing impulse is passed which by means of the apparatus to be described later at the receiving station is employed to control the speed of the receiving apparatus to insure proper framing and prevent distortion of the received picture. The white areas 18 may be omitted if sufficient white margin

always exists between the picture or printing matter being sent and the ends of the slot 3. At the receiving station the apparatus employed is more or less similar to that described above at the sending station. The light sensitive paper 20 upon which the picture is received is drawn slowly through the arcuate holder 21 which is similar to that used in the transmitter. The inner portion of the holder 21 is provided with a slot 22 through which the exposing light is projected. Centrally of the arcuate holder 21 is the rotatable system 23 comprising the hollow shaft 24 upon which is mounted the worm-wheel 25 meshing with the worm 26 which is driven by motor 27. Shaft 24 supports the two optical systems 28 and the prism 29 similar to that described above forming a part of the transmitter. Light from the discharge lamp 30 passes through the hollow shaft 24 and is reflected at right angles by the prisms 29 and focused by the optical system 28 to a spot on the sensitive paper 20. On shaft 24 we have shown the slip ring 32 of insulating material having imbedded in its periphery the metallic segment 33. Engaging the slip ring 32 are the two brushes 34 which at each rotation of the shaft are short circuited for a definite interval by the metallic segment 33. The purpose of this brush short circuiting arrangement will be described later.

The driving motor 27 which preferably is a D. C. motor of a type having inherently poor regulation is adapted to operate the rotating system 23 at a speed which is slightly greater than that of the corresponding member of the transmitter. For causing the rotating system 23 to operate at a speed which is synchronous with that of the corresponding part of the transmitter, we provide means for applying a variable load to the motor 27 which means is governed by the speed of the scanning device of the transmitter. As shown in Fig. 2 of the drawing, we employ the small A. C. generator 37 which is shown direct connected with the motor shaft and which is constructed to produce a frequency which is substantially equal to that produced by an electron discharge oscillator to be described later. Generator 37 is shown connected through the transformer 38 to the two electron discharge devices 39 and 40, the plates of which connect with opposite ends of the secondary of the transformer 38 while the two grids connect with opposite ends of the secondary of transformer 41. The two filaments connect with intermediate points of the aforesaid secondaries, the connection with the secondary of transformer 41 being through the battery 42. With this arrangement, sometimes referred to as a double-ended tube circuit or a push-push circuit, the devices 39 and 40 constitute in effect variable load resistances for the alternating current produced by generator 37. The electron discharge oscillator 44 feeds alternating current through the transformers 45 and 41 to the grids of devices 39 and 40, the frequency of the oscillation generator being normally the same as that produced by the generator 37. The frequency of the oscillations produced by the oscillator are however modified by means now to be described, which, under the control of the relative speeds of the receiving and transmitting apparatus modifies the voltage applied to the plate of the oscillator.

The facsimile and framing signals transmitted from the transmitter are received by the radio receiver 47 which may be of standard construction having the antenna 48, and through the transformer 49 feed impulses to the push-pull detector comprising the electron discharge devices 50 and 51. The output circuit of this detector connects through the electron discharge amplifier 52 with the flow or discharge lamp 30 by which the sensitive paper 20 is exposed. Electron discharge amplifier 53 having its grid and filament connected in parallel with the corresponding elements of device 52 has its plate circuit connected in series with the battery 54, the two brushes 34, the adjustable resistance 55 and the grid condenser 56, which latter is shunted by the grid leak 57. The terminals of the grid condenser 56 connect respectively with the grid and filament of electron discharge amplifier 58 whose plate connects with the plate of the oscillator 44, so that both plates are supplied by the same battery 59 through resistance 60.

In the operation of the apparatus impulses are sent out from the radio transmitter 16 in accordance with the variations in shade of the unit areas of the picture being transmitted and at the end of each scanning line a framing impulse is sent due to the dark portion of the paper holder at the end of the slot 3 of the transmitter. At the receiving station the picture impulses cause variations in the illumination of the discharge lamp 30 in the usual and well known manner. During each revolution of the rotating assembly of the receiver the metallic segment 33 closes the circuit between the two brushes 34 for a portion of the time during which the framing impulses are being received. During that time the battery 54 discharges through the variable resistance 55 into the condenser 56, a portion of the charge leaking around the condenser through the grid leak resistance 57. During the remainder of the rotation of the receiving apparatus the charge received by the condenser governs the potential of the grid of amplifier 58. Since the plate of the amplifier and the plate of the oscillator are both supplied from battery 59 through resistance 60, changes in current flow to the former affect the voltage applied to the latter and, as is well known, changes in voltage of the oscillator plate cause changes in the

oscillation frequency. This frequency which is applied to the grids of devices 39 and 40 normally is substantially the same as that produced by the generator 37 and which is supplied to the plates of said devices. The load taken by devices 39 and 40 depends upon the phase relation of the voltages applied respectively to the grids and the plates thereof. Thus it will be seen that a change in phase relation of the voltages applied to the grids and plates of devices 39 and 40 due to a change in oscillation frequency results in a change in the loading of the generator and accordingly a change in speed of the receiving apparatus. Under normal running conditions the interval of brush contact with the segment 33 does not exactly correspond with the interval of receipt of the framing impulse but the one overlaps the other, the time of overlap being just sufficient to give the condenser 56 the proper charge to maintain the oscillator at exactly the same frequency as that of the generator. The phase displacement of the voltages applied to the grids and to the plates of devices 39 and 40 is such as to impose the proper load on the generator. If however due to any one of various causes the speed of the receiver begins to increase or to decrease relative to that of the transmitter the change in overlap of framing impulse and period of short circuit of brushes 34 causes through a change in frequency of oscillation and a resulting change in phase in the loading devices 39 and 40, an increase or decrease respectively in the load imposed by the generator. It will be seen that the average voltage applied to the grid of device 58 depends upon the angular position of the receiving scanner with respect to the transmitting scanner which causes the framing impulses. It will also be seen that although a correction in the speed of the receiving scanner immediately follows any change in angular position thereof with respect to the transmitting scanner, the amount of corrective effect varies directly with the amount of correction necessary and the succeeding corrective impulses are accumulated if the necessary correction is very large; as for example at the commencement of the operation. Under certain conditions and to permit the use of an oscillator of smaller capacity we may employ an electron discharge amplifier between the oscillator and the devices 39 and 40.

We have chosen the particular embodiment described above as illustrative of our invention and it will be apparent that various modifications may be made without departing from the spirit and scope of our invention, which modifications we aim to cover by the appended claims.

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

1. In picture transmission apparatus including a sending device having means for producing framing impulses and a receiving device, means for driving the receiving device, and means for regulating the speed thereof, including an oscillator having a plate circuit, and an electron discharge device for varying the voltage applied to said plate circuit in accordance with the phase relation of said framing impulses and said driving means.

2. In picture transmission apparatus including a sending device having means for producing framing impulses and a receiving device, means for driving the receiving device, and means for regulating the speed thereof in accordance with said framing impulses including an oscillator having a plate circuit and an electron discharge device arranged to control the voltage applied to said plate circuit, said electron discharge device having a resistance capacity grid circuit of long time constant connected to receive the framing impulses under the control of said driving means whereby said circuit accumulates many correcting impulses and its resultant voltage governs the frequency of the oscillator.

3. In picture transmission apparatus including a sending device having means for producing a framing impulse at the end of each scanning line and a rotatable receiving device, a motor for rotating said receiving device, an oscillator arranged to control the speed of said motor in accordance with the frequency of oscillation, an electron discharge device having grid and plate circuits, said plate circuit being connected to control the voltage supplied to the plate circuit of said oscillator, a condenser connected with said grid circuit and arranged to be charged by said framing impulses and a circuit controlling device having a member rotatable in synchronism with said receiving device for controlling the proportion of the impulses received by the condenser.

In witness whereof we have hereunto set our hands this 29th day of October, 1930, and this 1st day of October, 1930.

HENRY R. BUTLER.
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