

March 15, 1932.

A. V. BEDFORD

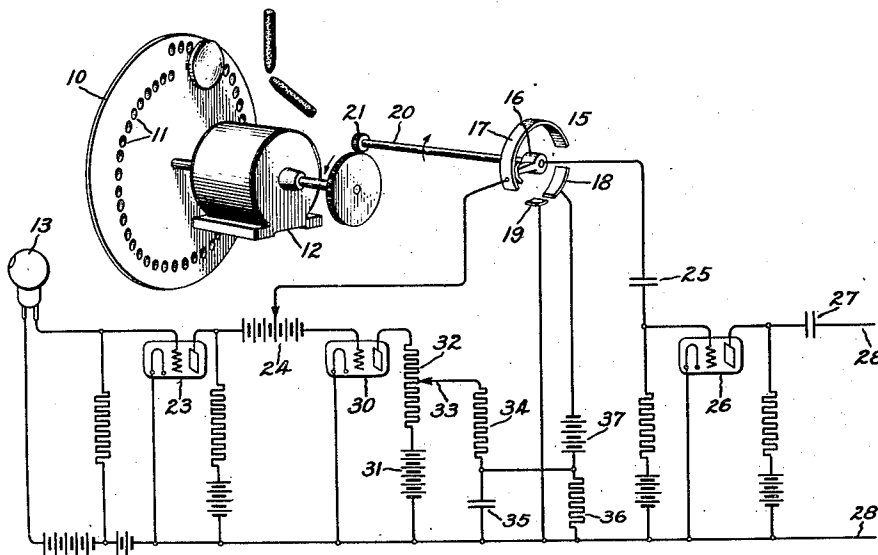
1,849,818

PICTURE TRANSMISSION

Filed Sept. 19, 1930

2 Sheets-Sheet 1

Fig. 1.



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2 Sheets-Sheet 2

Fig. 2.

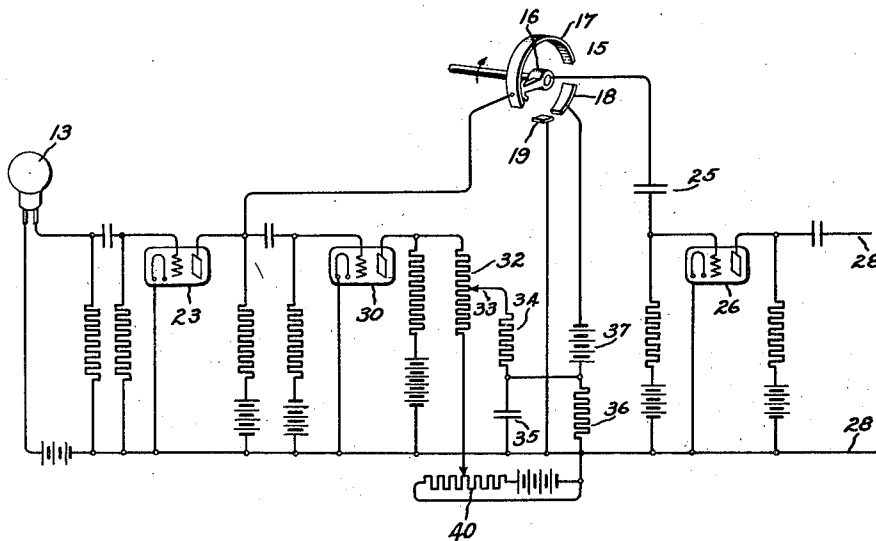


Fig. 3.

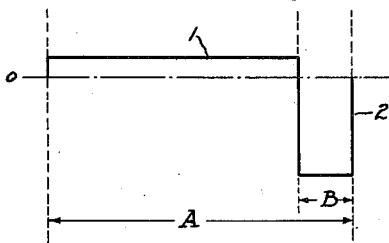


Fig. 4.

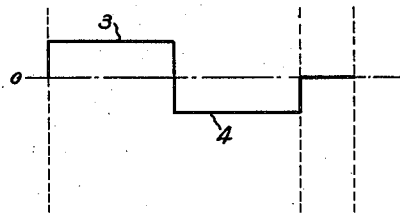
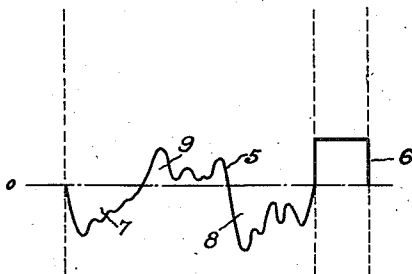


Fig. 5.



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## UNITED STATES PATENT OFFICE

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## PICTURE TRANSMISSION

Application filed September 19, 1930. Serial No. 483,033.

My invention relates to the transmission of pictures and particularly to the transmission of moving pictures or to television.

One of the difficulties encountered in present television systems is that of obtaining faithful amplification of the transmitted impulses over the wide range in frequency of such impulses heretofore found necessary. For example it is commonly considered that the lowest frequency which the amplifier should be able to handle with fidelity is that which corresponds to the transmission of a picture or view in which the upper half is light and the lower half is dark (or vice versa), the scanning being horizontal. For a 60 line picture transmitted at the rate of 20 pictures per second this would require a minimum frequency of 20 cycles per second. The highest frequency, considering the obtaining of equal definition up and down and from right to left of the picture, would be 36,000 cycles per second. It is the object of my invention to provide an improved television system wherein the necessary frequency range is greatly reduced, thereby partially if not entirely removing the aforementioned amplification difficulty.

As a result of my invention the minimum frequency which must be amplified, such as with a picture which is half light and half dark as described above, is raised from the number of pictures per second to the number of scanned lines per second. Thus in the case of the example given above the minimum frequency which the amplifier must handle is raised from 20 to 1200 cycles per second.

In accordance with my invention I scan the object whose image is to be transmitted and produce impulses corresponding to the shade variations in each line in the usual and well known manner. Invariably the light areas and dark areas scanned in a single line will not total the same but the one or the other will predominate, the positive and negative values of the impulses due to the light

and dark areas likewise predominating the one over the other. At the end of each line scanned I produce an auxiliary impulse of such a sign and of such value that when added to the impulses of that line a complete balance is effected. This in effect correctly locates the zero of the alternating picture frequency wave.

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

Referring to the drawings, Fig. 1 illustrates one embodiment of my invention; Fig. 2 shows a modified form of same; and Figs. 3, 4 and 5 are diagrams illustrating the theory of my invention.

Before describing the apparatus shown in Figs. 1 and 2, I shall first briefly describe the theory of my invention with the help of Figs. 3, 4 and 5. In each of these figures the distance A represents the time during which one line of the picture to be transmitted is scanned, and B represents the time devoted to the auxiliary signal impulse. In Fig. 3 it is assumed that the entire scanning line lies in a dark portion of the picture and that the resulting impulse is positive for the dark portion of the picture. The positive rectangular loop 1 therefore represents this scanning line of the picture. At the end of the line a negative impulse is produced which is proportional to the aforesaid positive impulse. This negative impulse is represented by the negative loop 2 whose area is proportional to the area of loop 1. A complete cycle is therefore produced for this scanning line and the zero line 0 is correctly located. In Fig. 4 it is assumed that the scanning line is uniformly dark for the first half of the line and uniformly light for the second half of the line. Consequently, the positive loop 3 and the negative loop 4 are equal to each other and no auxiliary signal impulse is

needed to produce a balance. In Fig. 5 the line 5 represents the impulses when the scanning line contains varying amounts of light and dark areas. At the end of the line an auxiliary signal loop 6 is shown of positive value which is equal to the sum of the two negative loops 7 and 8 minus the positive loop 9. The total positive and negative areas of the main signal impulse and the auxiliary signal impulse therefore are equal.

I shall now describe the apparatus by which this result is effected. In Fig. 1, I have shown the scanning device of a well known form comprising the disc 10 having a spiral roll of holes 11 therein connected to be driven by the motor 12 and the photoelectric cell 13 for receiving light reflected from the object being scanned. At 15 I have shown a contactor device comprising the rotatable arm 16 adapted successively to sweep over the long segment 17 and the two short segments 18 and 19. Arm 16 is rotated in synchronism with the scanning disc 10 being arranged to make one complete rotation for each scanning line. For this purpose I have shown the arm 16 connected by the shaft 20 with the shaft of the disc 10 through the gearing 21. It will be understood that the scanning mechanism illustrated is merely representative of any suitable scanning mechanism which may be connected in any desired manner with the contactor device 15.

The signal impulses produced by the photoelectric cell 13 are amplified by the electron discharge amplifier 23 whose output circuit connects through a portion of battery 24 with the long segment 17 of the contactor 15. Contact arm 16 connects through condenser 25 with the grid of electron discharge amplifier 26 whose plate circuit leads through condenser 27 to the output circuit 28. The impulses in this circuit may be transmitted to a distant receiving station by radio, wire line or any other suitable means. The signals received from the photoelectric cell are in part further amplified by the thermionic amplifier 30 whose grid connects with the battery 24 and whose plate connects with battery 31 through the variable resistance 32. The adjustable contact 33 of this resistance connects through resistance 34 with the condenser 35 whereby the condenser is charged to a level dependent upon the drop in potential across that part of resistance 32 between the adjustable contact 33 and battery 31. Condenser 35 is shown shunted by the resistance 36 which controls the time constant of the condenser. Battery 37 is connected between contactor segment 18 and that side of the condenser 35 which connects with the resistance 34. Segment 19 of the contactor connects directly with the opposite side of the condenser.

In the operation of the apparatus above described the object whose image is to be

transmitted is scanned in the usual and well known manner, the signal impulses from the photoelectric cell after amplification by the amplifier 23 being transmitted through the long segment 17 and arm 16 of the contactor device 15 to the amplifier 26 and thence to the output circuit 28. The long segment 17 of the contactor device is of such a length that the arm 16 remains in contact therewith during each scanning line and signal impulses are transmitted during that time in the usual manner. During the scanning of the line the varying current flow in the plate circuit of amplifier 30 due to the varying light and dark portions of the line produce a corresponding charge in the condenser 35. At the end of the line the arm 16 passes from the segment 17 to segment 18 without short circuiting 17 and 18. While the arm engages segment 18 the output circuit is in connection with the condenser 35 and battery 37. If the voltage of the condenser exceeds that of the battery, it will act through the battery sending an impulse of one sign to the output circuit and if the battery has a greater voltage than the condenser the battery will send an impulse of the opposite sign to the output circuit. As arm 16 passes on to segment 19, the arm bridges segments 18 and 19 whereby the condenser is permitted to discharge or to be charged to the level of the voltage of battery 37. From segment 19 the contact arm 16 passes on again to the long segment 17 which corresponds to the beginning of a new scanning line. In this operation condenser 35 might be considered as an energy storing means, the energy flowing into the condenser from battery 31 during the scanning of a line being considered as a positive storage and the energy flowing out of the condenser during such scanning being considered a negative storage. At the end of each scanning line the resulting voltage of condenser 35 is compared to that of battery 37. If the two voltages happen to be equal, no auxiliary impulse is produced. If the condenser voltage is less than that of battery 37, an impulse of one sign is produced and if the voltage of condenser is greater than that of the battery, an auxiliary impulse of the opposite sign is produced. In each case the magnitude of the impulse is proportional to the difference between the light and dark portions of the scanning line. Thus the auxiliary signal is such as to cause the amplifier system essentially to recover its equilibrium after its unbalanced condition resulting from any lack of equality of dark and light signals from each line.

In the distant receiver illumination of the recording light during the time of the auxiliary signal is not desired since it forms no part of the picture and therefore should preferably be masked off by a suitable screen or barrier placed along either the right or

left hand or both borders of the received picture. This light as far as the received picture is concerned is superfluous and exists solely because of the apparatus for keeping the picture in balance. The above described system I have accordingly called the "scrap pile border system". Since a lamp in the plate circuit of any A. C. amplifier tends to supply a constant value of average light, whenever any line of the picture has other than this average amount of light, the difference either positive or negative is supplied by the "scrap pile".

In Fig. 2 I have shown a modified form of my invention in which the amplifiers 23 and 30 are coupled not for the amplification of direct current but for a low frequency alternating current since it is desired that they handle the picture frequency. In this form of my invention the D. C. component of the potential applied to segment 18 is adapted to be manually controlled by the use of the adjustable resistance 40. I may, however, employ an auxiliary photo-electric cell to control this potential in accordance with the general illumination of the picture.

While I have shown the contactor 15 as comprising the three segments, I may employ a contactor having a greater number of contacts. For example, the number of contacts may be multiplied by ten whereby the speed at which the arm must rotate would be reduced to one tenth of that necessary when but three contactors are employed.

From the above description it will be seen that in accordance with my invention the average illumination of a picture is controlled by the illumination of the object whose image is being transmitted. This advantage becomes particularly important in the case of multiple light source colored television, since without ability to control the average intensity of each color in the received picture, every picture would have the same average amount of each color in it regardless of how much of each of those colors there was in the original object. For example, if no red were present in the object, red light would not be forced into the received picture but the red signal which is required to keep the amplifier in balance would be put into the "scrap pile" or part B.

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

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

1. In television transmission, the method which comprises scanning line by line the object whose image is to be transmitted, pro-

ducing impulses during said scanning in accordance with the shade variations in each line and producing at the end of each line an auxiliary impulse whose magnitude substantially corrects any unbalance in light and dark portions of the line.

2. In television transmission, the method which comprises scanning line by line the object whose image is to be transmitted, producing impulses during said scanning in accordance with the shade variations in each line and producing an auxiliary impulse at the end of each line having a value approximately proportional and opposite in sign to the average signal of that line.

3. In television transmission, the method which comprises scanning line by line the object whose image is to be transmitted, producing positive and negative impulses in accordance with the light and dark areas in each line and producing an auxiliary impulse at the end of each line in accordance with any inequality in the light and dark areas of said line.

4. In television transmission, the method which comprises scanning line by line the object whose image is to be transmitted, producing impulses during said scanning in accordance with the shade variations in each line, storing energy during the scanning of each line in accordance with the predominance of the light portions thereof and producing an auxiliary impulse at the end of each line substantially proportional to the stored energy.

5. Television transmission apparatus comprising means for scanning the object whose image is to be transmitted, means for producing impulses in accordance with the shade variations in each scanning line, and means for producing an auxiliary impulse at the end of each line having a magnitude corresponding to the predominance of light or dark portions in said line.

6. Television transmission apparatus comprising means for scanning the object whose image is to be transmitted, means for producing impulses in accordance with the light and dark portions in each scanning line, and means for producing an auxiliary impulse at the end of each line substantially proportional to any inequality in the impulses due to the light impulses and the dark impulses.

7. Television transmission apparatus comprising means for scanning the object whose image is to be transmitted, means for producing impulses in accordance with the light and dark portions in each scanning line, and means for producing a corrective impulse at the end of each line comprising means for storing energy controlled by the relative areas of the light and dark portions of the line and means for causing said energy to be released at the end of the line.

8. Television transmission apparatus com-

prising means for scanning the object whose  
image is to be transmitted, means for pro-  
ducing impulses in accordance with the light  
and dark portions in each scanning line, and  
means for producing a corrective impulse at  
the end of each line comprising a condenser,  
means for varying the charge thereof in ac-  
cording with the predominance of impulses  
from the light or the dark portions of said  
line and means for comparing the remaining  
charge of the condenser with a reference volt-  
age source.

In witness whereof, I have hereto set my  
hand this 16th day of September, 1930.

ALDA V. BEDFORD.