Oct. 24, 1939. P. C. GOLDMARK 2,177,365

METHOD AND APPARATUS FOR TELEVISING A PICTURE FILM

Filed May 9, 1936 2 Sheets-Sheet 1

Fig. 1.

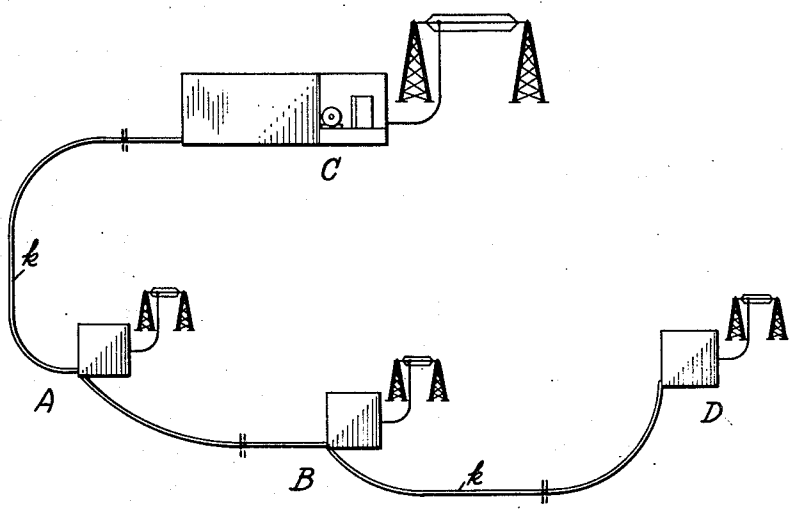


Fig. 2.

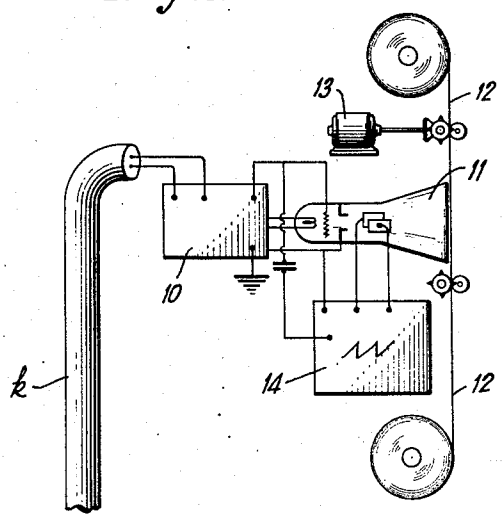
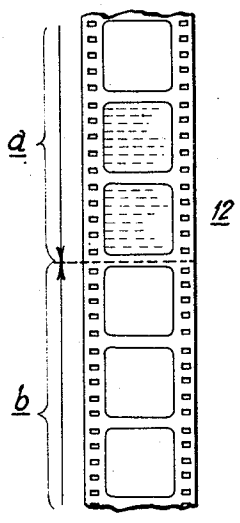


Fig. 3.



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Fig. 4.

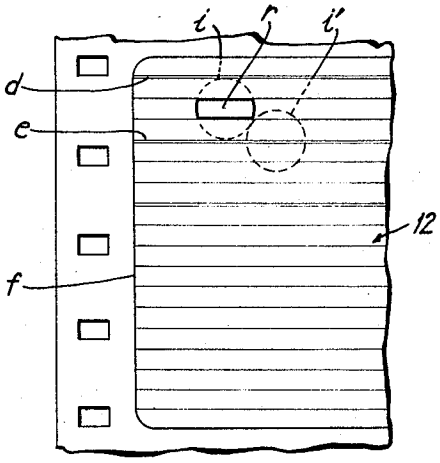


Fig. 5.

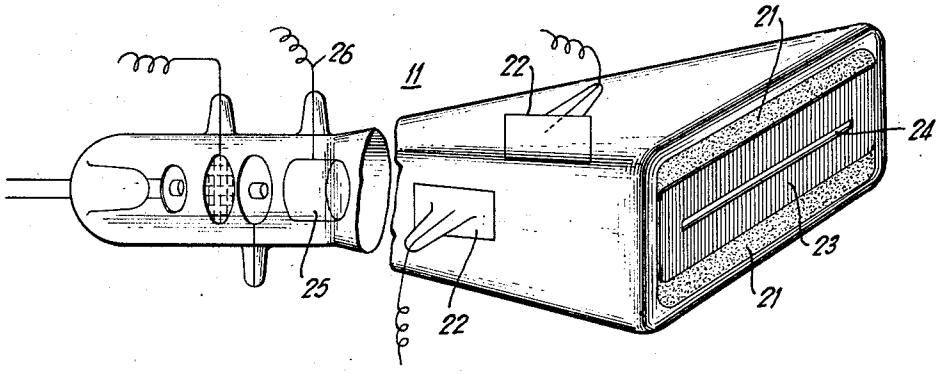
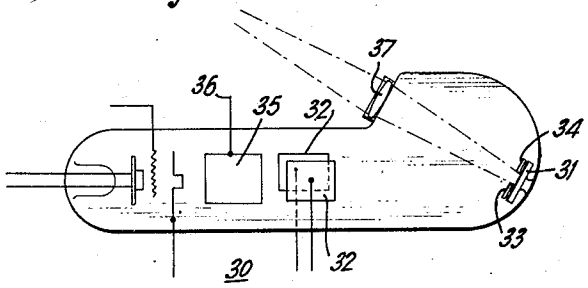


Fig. 6.



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METHOD AND APPARATUS FOR TELEVISING A PICTURE FILM

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Application May 9, 1936, Serial No. 78,785

9 Claims. (Cl. 178—6.7)

This invention relates to a method and apparatus for producing and transmitting a picture film in the art of television.

More specifically, the invention relates to a method and apparatus for collecting picture material of the character usually going into newsreel films, at a plurality of outlying stations, and transmitting the same to a central broadcasting station, where it is edited and arranged for retransmission to the several outlying stations for simultaneous broadcasting at a later desired time.

The invention has for its object generally to provide an improved method of collecting and distributing news picture material together with special televising steps, whereby the collected material may be distributed in a manner adapted for exhibition in theaters, clubs, auditoriums, and the like.

Another object is to provide a service between a plurality of outlying stations and a central station which will result in increased earnings for the rented cable connecting the same.

Still another object is to provide a master film by exposure to scansion with a multiple of a standard or predetermined number of lines, whereby a record is provided which may be rescanned and reproduced with standard apparatus to give pictures having a high degree of fidelity.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the several steps and the relation of one or more of such steps with respect to each of the others, and the apparatus embodying features of construction, combinations of elements and arrangement of parts which are adapted to effect such steps, all as exemplified in the following detailed disclosure, and the scope of the invention will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention reference should be had to the following detailed description taken in connection with the accompanying drawings, in which:

Fig. 1 is a diagrammatic view, showing a plurality of broadcasting stations connected by a cable and arranged for collecting and distributing picture material in accordance with the invention;

Fig. 2 is a view, mainly symbolic, showing an arrangement of picture receiving and film reproducing apparatus employed in the practice of the invention;

Fig. 3 is a fragmentary view of a portion of the film reproduced by apparatus shown in Fig. 2;

Fig. 4 is an enlarged fragmentary view of a portion of the film shown in Fig. 3, marked to illustrate the manner in which the improved scanning step is practiced in accordance with the invention;

Fig. 5 is a fragmentary view showing an improved cathode ray tube used to practice the improved scanning step illustrated in Fig. 4; and

Fig. 6 is a modified form of cathode ray tube that may be employed in the practice of the invention.

It is common practice to broadcast the same program from a chain of radio stations in the radio art today, and, for this purpose, a group of stations are connected by cable, over which the modulating impulses from a central studio are transmitted for broadcasting. The connecting cable in general is not the property of the broadcasting stations but is generally rented from a communication utility company on a so-called "all time" basis, i. e., a rental sum is agreed upon and paid, even though the connecting cable is expected to be used only part of the time; the stations in the chain being constantly connected with the cable. The earning capacity of the stations may, therefore, be increased by finding new uses for the connecting cable.

By the present invention, it is proposed to provide a newsreel film producing service which uses the cable during the present unused periods. To this end, it is proposed to collect newsreel material in the localities of the several outlying stations in the chain and to transmit such newsreel material to the central station over the cable at predetermined periods during the morning hours. It will be understood that, for the best use of the cable in this manner, each station connected to the cable should transmit the news picture material, which it has collected, to the central station only during its own predetermined assigned period.

As a result, the transmitted signals will be received successively at the central station and are then translated into facsimile pictures on a strip of film that is a reproduction of the film originally made photographically at the outlying stations. These reproduced facsimile pictures are then edited and arranged in a desired sequence and formed into a master film, which is used to effect the transmission at desired times of the collected newsreel material back to the several outlying stations simultaneously, where the newsreel material is broadcast and/or exhibited in moving-picture theaters, clubs, auditoriums, and the like.

In this retransmission of the picture material from the central station, it is desirable, of course, to make use of standard apparatus as far as practical and to scan pictures with a standard or predetermined number of lines. If the master film were made in the ordinary way, its scansion for retransmission presents the problem of confining the scanning light spot to the lines originally scanned, where a high degree of fidelity and definition is to be achieved. Otherwise, it

is seen that, when the scanning light spot wanders somewhat, it traverses the seam joining two lines, with the result that the line element impulses transmitted will lack ability to supply detail in their modulating effect. When it is remembered that the picture is to be scanned by putting in several hundred lines in a small space, it is seen that the maintenance of such a degree of accuracy in the position of the light spot as to avoid this wandering effect requires the maintenance of a constancy in the condition of the scanning devices that it is not practical to obtain.

By the present invention, the necessity for the maintenance of such conditions is avoided, for the original scansion of the picture material from the outlying stations and reproduction of the same at the central station are effected by means of a moving light spot which is moved to put in a multiple of the number of lines normally put in when scanning with the original predetermined number of lines, as here proposed for the master film. This multiple may be two or three times such standard number, while the frequency with which the picture impulses are transmitted may be reduced in order to reduce the sideband frequencies which the cable is otherwise required to accommodate. For example, if the master film is to be scanned with 343 lines, the original scansion of the picture material transmitted to the central station may be with 1,029 lines, and the frequency of transmission reduced to half speed.

To provide a scanning light spot adapted to put in three lines on the scanned film where but one is finally to be provided, an improved cathode ray tube is employed. Such tube may well take the form of a line-scanning cathode ray tube, which has a cathode ray beam impinging upon a line-like fluorescent screen arranged to give a scanning light spot decreased in diameter in the direction in which the number of lines is increased without decreasing the brilliancy. It may be desired also to decrease the ligh spot in the direction of the lines, in order to increase the definition.

Referring now to the drawings, and particularly to Fig. 1, a plurality of stations in a chain are denoted A, B, C and D, respectively. These stations are shown as connected by means of a cable *k* (which may be taken as having two or more conductors arranged concentrically), the station C being the central station to which the picture signals are transmitted over the cable *k* at predetermined assigned periods; for example, station A may be assigned the period from 8:00 A. M. to 8:15 A. M. to transmit picture signals to station C. Similarly, station B may be assigned the period from 8:15 A. M. to 8:30 A. M. to transmit its picture material to station C; and likewise, station D may be assigned the period from 8:30 A. M. to 8:45 A. M. The picture material is preferably collected on moving-picture film in the vicinities of the stations A, B and D in any known manner and then transmitted to the central station C in a suitable manner, so as to make facsimile picture material reproduced on films, which is then edited and rearranged to provide a film, made by the ordinary processes practiced in the cinematographic art, that may be styled a "master film" and has the picture material thereon arranged in a desired sequence.

Apparatus of the general type shown in my prior application, Serial No. 72,009, filed April 1, 1936, when adjusted to give the scanning frequency here desired, is suitable for scanning the transmitted and received films in accordance with the practice of the present invention. A more simple form of suitable scanning apparatus arranged for receiving purposes, however, is shown in Fig. 2, where a cathode ray tube **11** (details of the tube being shown on an enlarged scale in Fig. 5) is employed as the scanning instrumentality.

In Fig. 2, an end portion of the cable *k* is shown, having conductors leading to a demodulating and amplifying stage **10**. Coupled to the stage **10** is the cathode ray tube **11** before the scanning light spot of which an unexposed film **12** is made to pass by suitable means, such as the synchronous motor shown at **13**. The movement of the scanning light spot is controlled by means of a high frequency saw-toothed wave oscillator **14**. For transmitting purposes, the cable *k* is not connected to the tube **11**. Instead, it is connected to receive a signal from a suitable device (not shown) under the control of a photoelectric cell placed to be actuated by light from the light spot when modulated by passage through the film being scanned.

The portion of the film **12**, which is made when receiving exposure to the motion of the light spot controlled by signals received through the cable from the station A, will produce a section scanned with the multiple of a standard number of lines as here proposed; for example, with 1,029 lines for a given picture space. Such portion or section is indicated at *a* in Fig. 3 and extends down to and terminates at a midportion in the figure.

When picture signals cease to come in from station A, the apparatus may be stopped, in the event that the time for the arrival of picture signals from station B has not yet come to pass. When picture signals from station B arrive, the apparatus at the central station, shown in Fig. 2, again comes into commission. Either a new film may be exposed, or a section *b* of film adjoining section *a*, as shown in Fig. 3, may be produced. The section from the station D is, of course, produced at the proper time. The manner in which the scanning at high frequency is practiced is shown more in detail in Fig. 4.

In Fig. 4, a fragmentary portion of the scanned film is indicated on an enlarged scale, showing the manner in which scansion is effected. Here, a frame is denoted at *f*, and is indicated as scanned horizontally by means of a series of lines. An ordinary line, for example, that put in when scanning with 343 lines, is indicated as extending across the space between the lines *d* and *e*. The scanning light spot, which would put in such a line, is indicated by the circle *l*, shown in broken lines, which would move horizontally across the frame *f*. If this film were to be rescanned at 343 lines, it is seen that, in the event that the light spot should move or wander for any reason to the position denoted at *l'*, then the light spot would have its central portion moving over the boundary portion denoted by the line *e* and would fail to supply definition. By increasing the scanning frequency of the film going to make the master film so as to put in three times the number of lines in the frame *f* which would otherwise have been put in, this failure to supply definition is avoided.

To scan either a transmitting or receiving film in the manner shown in Fig. 4, the cathode ray tube, shown somewhat in detail in Fig. 5, is provided with the usual electron gun and with an elongated fluorescent screen **21** at the front across which is moved the cathode ray beam by means of a pair of deflecting plates shown at **22**.

These plates oscillate the beam so as to produce a scanning light spot moving linearly across the fluorescent screen, while the film is moved constantly downward before it.

To insure the putting in of the desired detail at this high scanning frequency, it is desirable to reduce the size of the scanning light spot to an extent proportional to the increase in frequency, particularly in the direction in which the number of lines is increased. That is, for 1,029 lines, instead of 343, it is desirable to have the vertical diameter reduced to but one-third that of the circle *l*. The reduced light spot for thus putting in lines is indicated by the rectangle *r* on the frame *f*.

To reduce the light spot to the size of rectangle *r*, or other suitable configuration, several means of reduction are available, such as optical systems, electrical shielding and mechanical screening. The optical method usually results in an undue loss of light and the use of shielding and screening means is preferred. To effect the desired reduction solely by screening means, the tube **11** is provided with a mask **23**, having a slot **24** of desired width, so associated with the fluorescent screen that the effective area of the light spot is reduced by the slot **24** to the desired size. As shown, this mask has portions at each side of the slot disposed lengthwise of the fluorescent screen so as to cut off portions of the light spot at each side of the line along which it moves. This mask, while it may be provided either inside or outside of the tube, is preferably outside the tube and over the fluorescent screen. In this position, very effective screening may be had by the provision of a non-fluorescent mask when cut to have a slot of the desired width. To reduce the length of the light spot a conducting shield or focusing element, as shown in the tube at **25**, may be provided; such shield being connected to a suitable source of potential, as by conductor **26**. It will be understood that when reduction of the light spot is desired either of these methods of reduction may be employed, or both. Where electric shielding is employed, the voltage between cathode and anode employed in the tube may need to be increased. This increase, however, is well understood and is readily provided.

In operation, it is seen that when transmitting pictures of 1,029 lines at 24 frames a second, from an outlying station to the central station, a frequency of 5.8 megacycles is required. Since, however, time of transmission from an outlying station to the central station is not an important factor, it is proposed to reduce this frequency, it being advantageous to reduce the frequency by one-half, that is, to a frequency of 2.9 megacycles, so as to produce but 12 frames per second. The increased definition obtained when scanning the master film produced from material, transmitted by the greater number of lines, makes possible the retransmission and reproduction of the newsreel film picture material with a relatively high degree of faithfulness.

In the modified form of the tube shown in Fig. 6, there is a glass envelope, shown generally at **30**, which has an electron gun at the cathode end and a fluorescent screen **31** mounted at the target end and disposed at an angle to the axis of the tube. Deflector plates **32** deflect the beam of electrons so as to travel from side to side along the screen **31**. On the screen are mask portions **33** and **34** cutting off all but a small width of screen along which the beam is to travel. A shielding or focusing element **35** is also shown in the tube for receiving a charge through conductor **36**. A lens **37** is also provided in the wall of the tube to project the light beam from the light spot on the screen **31** to a desired point, such as into a camera box where a film is being exposed. Such tube, it will be readily understood, may be substituted for that shown at **11** in Fig. 2.

It will be understood also that, in the production and reproduction of picture material, as here proposed, either in outlying stations or at the central station, any standard film may be employed, for example, either 16 mm. or 35 mm. film. The master film produced at station C is, of course, accommodated to the standards of the apparatus employed for producing and reproducing pictures in accordance with the invention.

The transmitted picture material when produced with a multiple of a standard number of lines has been found to have sufficient detail that the projection of the pictures may be readily accomplished upon a screen so that they may be viewed in moving-picture theaters, clubs, auditoriums, and the like, with a large measure of satisfaction and joy, when using either the master film or the locally made film, as the case may be. The production of the local film and projection of the same may be accomplished with any suitable device, for example, with standard apparatus, putting in a standard number of lines, as disclosed in my application, Serial No. 14,819, filed April 5, 1935.

When transmitting picture material, as here proposed, accompanying sound is generally desirable. This can, of course, be provided by the use of channels entirely separate from the picture transmitting channel. It is preferable, however, to make use of the picture channel and in my application, Serial No. 14,819, one method of transmitting sound and picture material simultaneously over one channel is disclosed. The master film as here provided is made in accordance with such process with a sound track on the film accompanying the pictures, the whole being televised to desired receivers where the sound and pictures are separately but at the same time reproduced. Such accompanying sound on the master film may be the comments of a commentator made when producing the master film, rather than original sound effects recorded at the time the original pictures were taken.

It will be understood that, while the multiples given in the examples above are higher multiples of the numbers taken as the original numbers of lines, it is contemplated using lower or sub-multiples of the original numbers of lines, and it is desired that it be understood that such lower or submultiples are embraced by the term "multiple".

Since certain changes in carrying out the above process and in the constructions set forth, which embody the invention, may be made without departing from its scope, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

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

1. The method of televising picture material between a plurality of stations connected by cable, which comprises making picture material on film frame areas of a film at each of a plurality of outlying stations, scanning said film frames at each of said plurality of stations at a frame scanning rate substantially less than normal and

in a higher multiple of a standard number of lines per film frame for transmitting picture signals by cable to a central station, translating said received picture signals at said central station into facsimile pictures on a recording film, and thereafter scanning the recording film at a rate which is normal and puts in a standard number of lines for televising the same to said outlying stations.

2. The method of televising picture material between a plurality of stations connected by cable, which comprises making picture material on film frame areas of a film at each of a plurality of outlying stations, scanning film frames of said film so made at each of said plurality of stations during consecutive periods with a moving light spot that puts in a higher multiple of a standard number of lines per film frame, transmitting picture signals produced by said scansion at each of said outlying stations to a central station at a frame scanning rate substantially below normal, translating said received picture signals at said central station into a record film having portions corresponding to the signals consecutively received from said outlying stations, and thereafter transmitting by cable picture signals modulated by said record film which is scanned by a moving light spot that puts in said standard number of lines at said normal frame scanning rate.

3. The method of televising picture material to be broadcast at a selected number of lines per frame and a selected number of frames per second which comprises televising the picture material to a receiving station with a substantially greater number of lines per frame than said selected number of lines per frame and at a substantially smaller number of frames per second than said selected number of frames per second, recording the received picture material, and subsequently broadcasting the recorded picture material at said selected number of lines per frame and at said selected number of frames per second.

4. The method of televising picture material to be broadcast at a selected number of lines per frame and a selected number of frames per second which comprises televising the picture material to a receiving station with a substantially greater number of lines per frame than said selected number of lines per frame and at a substantially smaller number of frames per second than said selected number of frames per second, recording the received picture material on frames of a film, and subsequently broadcasting the pictures recorded on the film frames by scanning said frames at said selected number of lines per frame and at said selected number of frames per second.

5. The method of televising picture material to be broadcast at a selected number of lines per frame and a selected number of frames per second which comprises transmitting the picture material to a receiving station by scansion which gives a higher multiple of said selected number of lines per frame and a substantially smaller number of frames per second than said selected number of frames per second, recording the received picture material on frames of a film, and subsequently broadcasting the pictures recorded on the film frames by scanning said frames at said selected number of lines per frame and at said selected number of frames per second.

6. The method of televising picture material to be broadcast at a selected number of lines per frame and a selected number of frames per second which comprises producing two-dimensional image frames of the picture material, televising said two-dimensional image frames from a transmitting station to a receiving station with a substantially greater number of lines per frame than said selected number of lines per frame and at a substantially smaller number of frames per second that said selected number of frames per second, recording two-dimensional image frames of the received picture material, and subsequently broadcasting the said received picture material by scanning the last-mentioned two-dimensional image frames at said selected number of lines per frame and at said selected number of frames per second.

7. The method of televising picture material to be broadcast at a selected number of lines per frame and a selected number of frames per second which comprises producing on film two-dimensional film-frame images of the picture material, televising said two-dimensional film-frame images from a transmitting station to a receiving station with a substantially greater number of lines per frame than said selected number of lines per frame and at a substantially smaller number of frames per second than said selected number of frames per second, recording on film two-dimensional film-frame images of the received picture material, and subsequently broadcasting the said received picture material by scanning the last-mentioned two-dimensional film-frame images at said selected number of lines per frame and at said selected number of frames per second.

8. The method of televising picture material to be broadcast at a selected number of lines per frame and a selected number of frames per second which comprises producing two-dimensional image frames of the picture material, televising said two-dimensional image frames from a transmitting station to a receiving station with a greater number of lines per frame than said selected number of lines per frame and at a substantially smaller number of frames per second than said selected number of frames per second, said greater number of lines per frame being substantially a multiple of said selected number of lines per frame, recording two-dimensional image frames of the received picture material, and subsequently broadcasting the said received picture material by scanning the last-mentioned two-dimensional image frames at said selected number of lines per frame and at said selected number of frames per second.

9. The method of televising picture material to be broadcast at a selected number of lines per frame and a selected number of frames per second which comprises producing two-dimensional image frames of the picture material, televising said two-dimensional image frames from a transmitting station to a receiving station by scansion with a scanning spot which scans said image frames with a substantially greater number of lines per frame than said selected number of lines per frame and at a substantially smaller number of frames per second than said selected number of frames per second, the dimension of said scanning spot being substantially greater in the direction of said lines than in the direction perpendicular to said lines, recording two-dimensional image frames of the received picture material, and subsequently broadcasting the said received picture material by scanning the last-mentioned two-dimensional image frames at said selected number of lines per frame and at said selected number of frames per second.

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