July 14, 1942. K. R. HOYT 2,289,427

RADIO VISION TRANSMITTING RECORDING AND REPRODUCING APPARATUS AND METHOD

Filed May 22, 1940 5 Sheets-Sheet 1

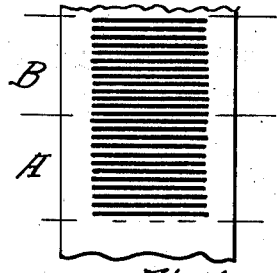


Fig. 1.

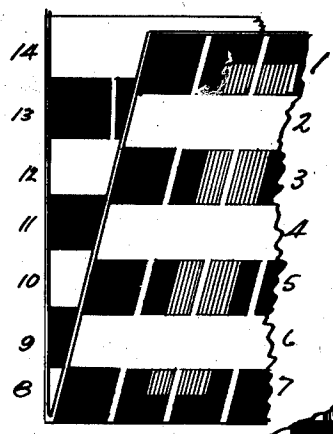


Fig. 2.

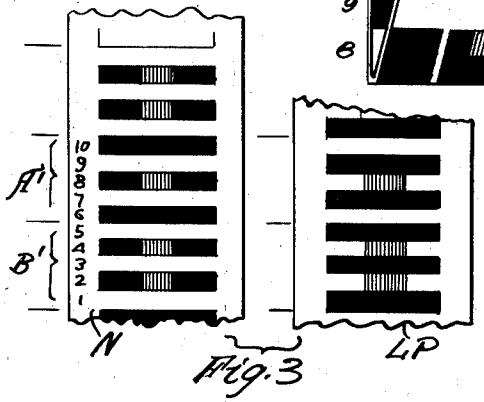


Fig. 3

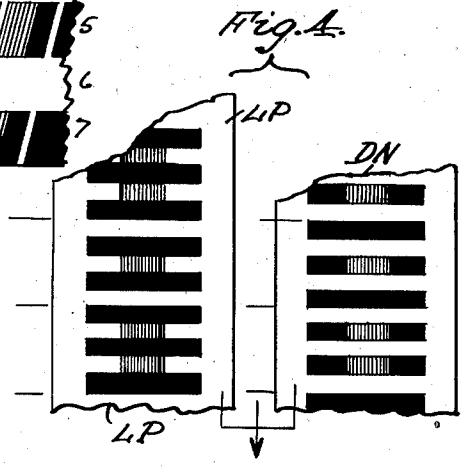


Fig. 4.

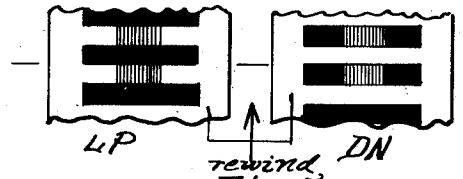


Fig. 5.

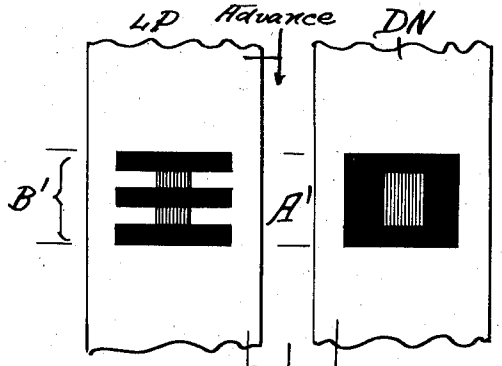


Fig. 6.

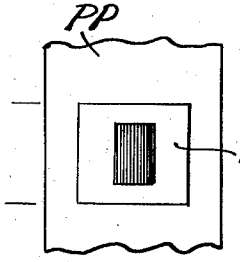


Fig. 7.

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RADIO VISION TRANSMITTING RECORDING AND REPRODUCING APPARATUS AND METHOD

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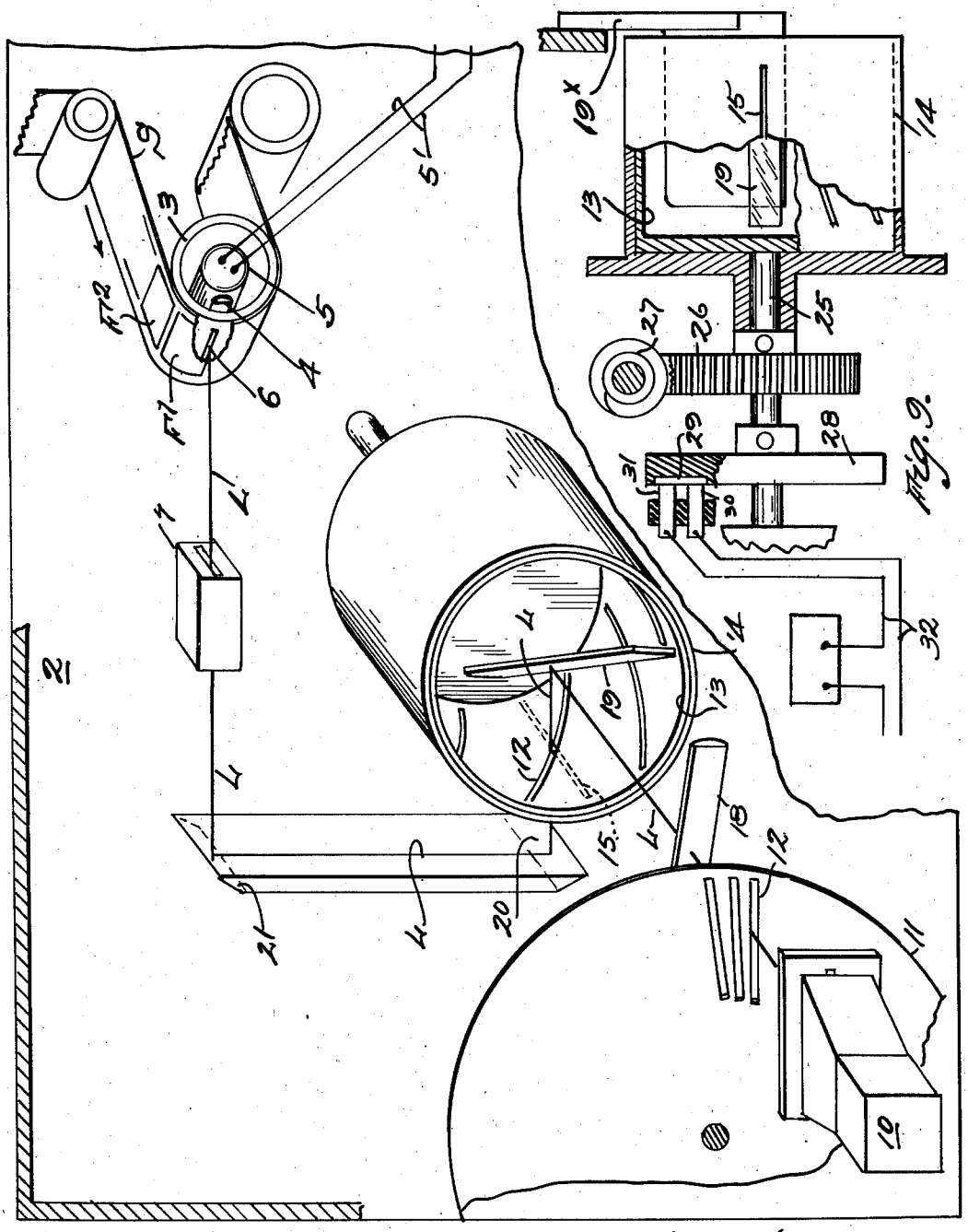


Fig. 9.

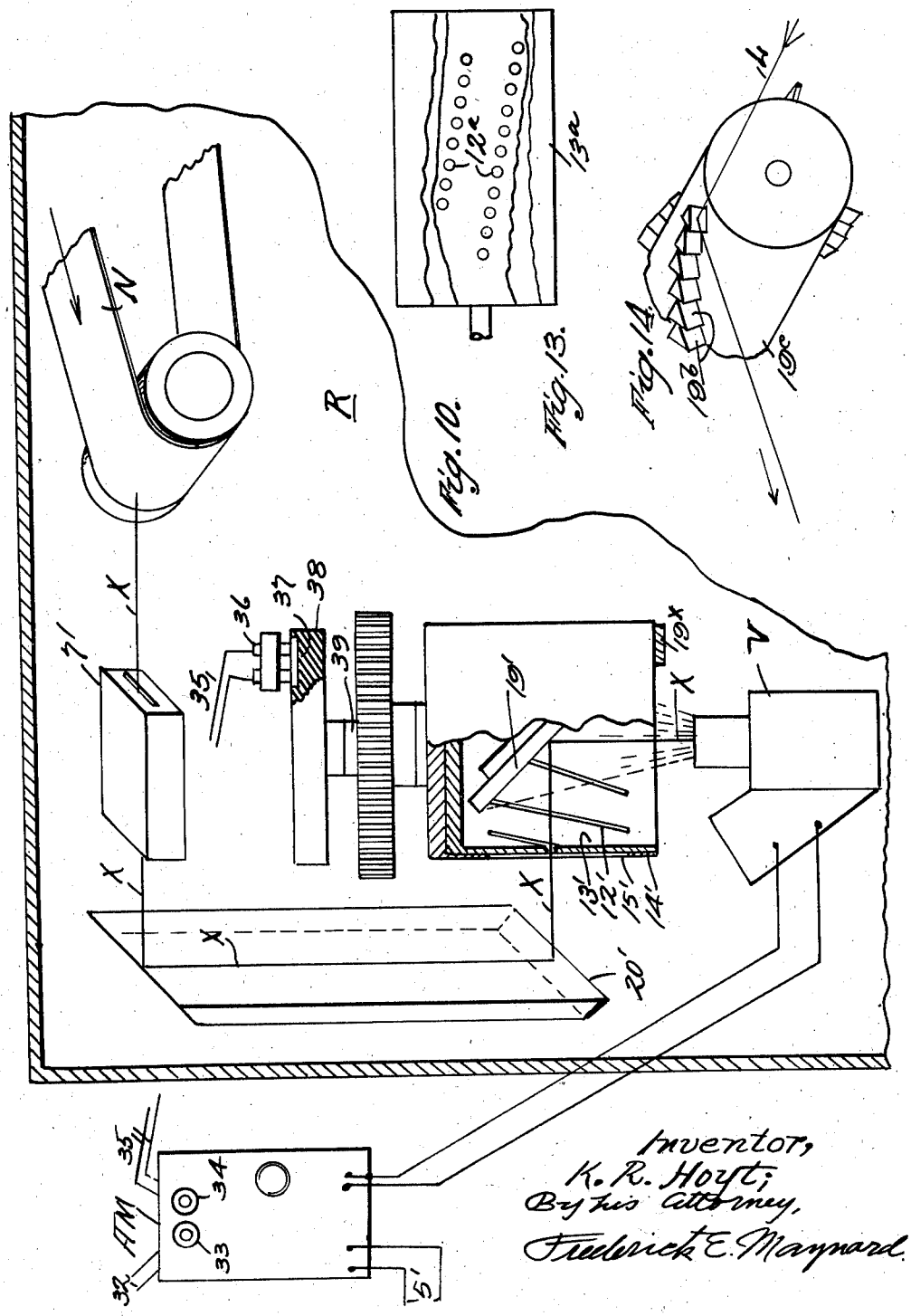
Fig. 8.

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RADIO VISION TRANSMITTING RECORDING AND REPRODUCING APPARATUS AND METHOD

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RADIO VISION TRANSMITTING RECORDING AND REPRODUCING APPARATUS AND METHOD

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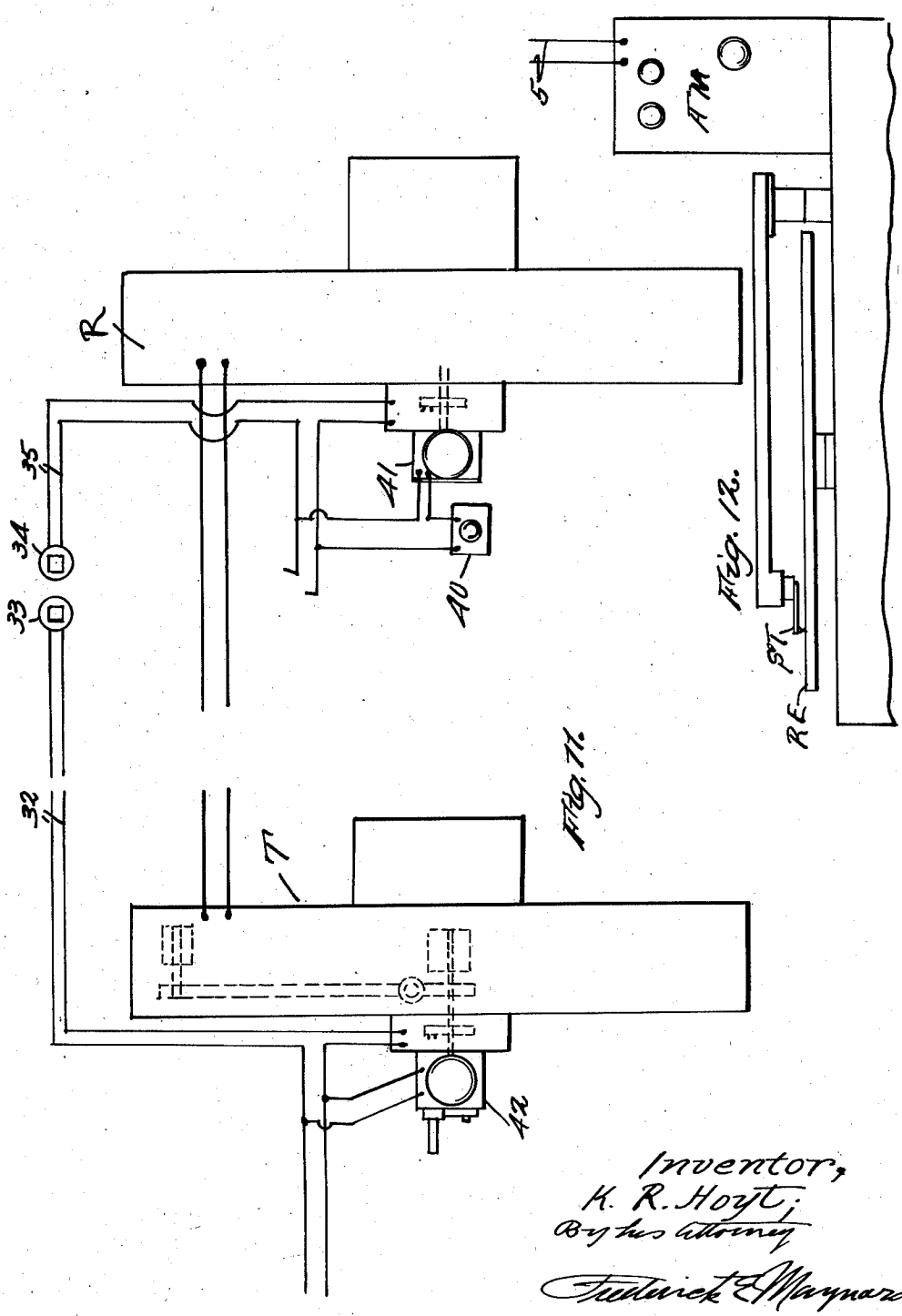


Fig. 12.

Fig. 11.

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RADIO VISION TRANSMITTING RECORDING AND REPRODUCING APPARATUS AND METHOD

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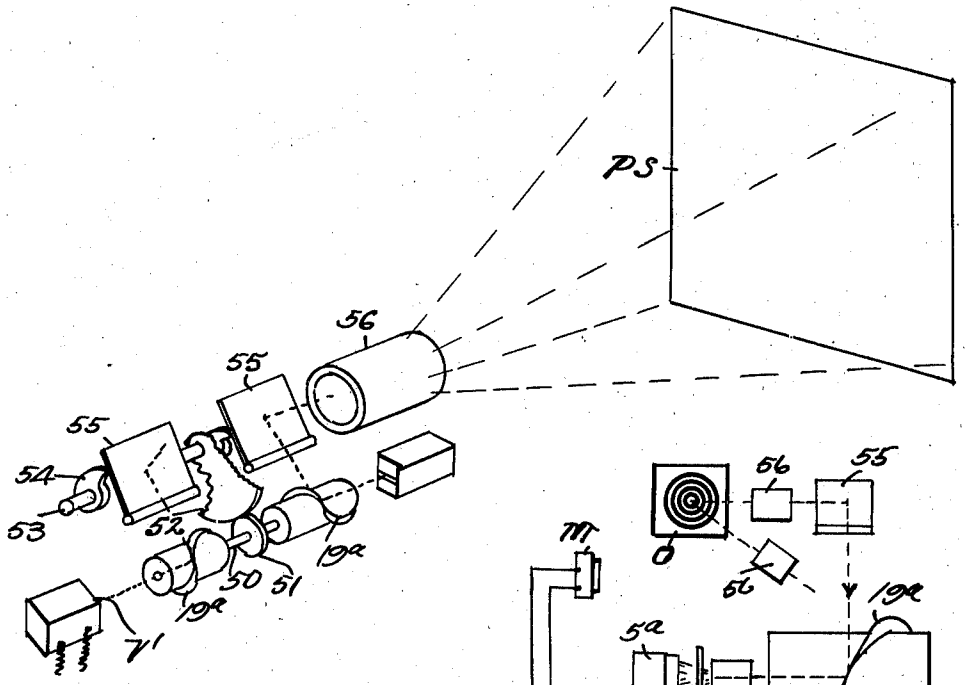


Fig. 15.

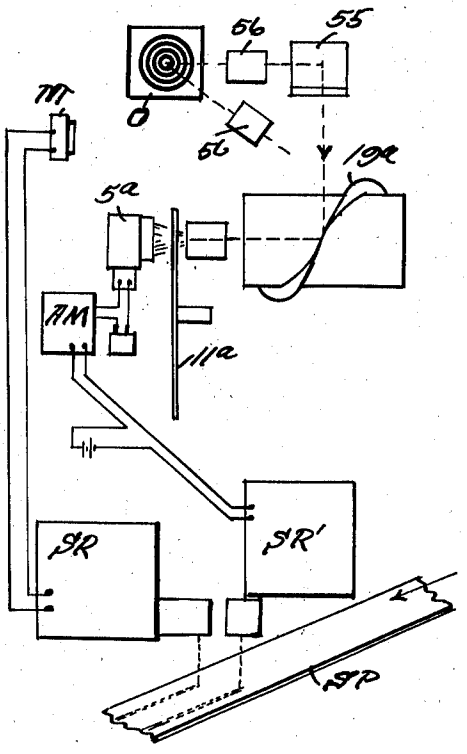


Fig. 16.

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UNITED STATES PATENT OFFICE

2,289,427

RADIO VISION TRANSMITTING, RECORDING, AND REPRODUCING APPARATUS AND METHOD

Karl Robert Hoyt, Los Angeles, Calif., assignor to Radio-Vision Corporation of America, a corporation of California

Application May 22, 1940, Serial No. 336,617

7 Claims. (Cl. 178—6.7)

This invention is a method and apparatus for the conversion of an objective field, of a translucent nature, into a train of electrical impulses (from a suitable generative source) which may be transmitted by any suitable carrier, as by radio currents, or by line conductor, or by light waves or other suitable and appropriate medium, and which impulses are individually determined by virtue of the density, in relation to light transmitting capacity, and which impulses are adapted for utilization to obtain various products or results, such, for instance, as the making of impulse records for purpose of reproduction of the original impulses, or may be used to excite electrical receivers whereby to translate the incoming impulses into a desired product, such as a physical picture element or a projected, screen picture; either still or motion.

The invention is, further, a method and apparatus for the utilization of the electric impulses just described and includes the combination of a suitable recording medium in one adaptation of the invention, for preserving, reproducibly, the received impulses, and on the other hand includes the combination of means directly receiving the impulses and immediately applying them to a given purpose such as the reproduction, photographically, of the original, objective field whence the impulses were derived.

Stated otherwise, the invention is a method and means for producing electric impulses by the sweeping (or if preferred, scanning) with a light pencil a given objective field of a physical character enabling the pencil to partly pass through in intensities controlled directly and only by the degree of translucency of the various portions of the field swept by the pencil.

The word "scanning" where used herein is not in the sense of viewing the objective field to see its reflected or original light for any functional purpose, but in this method a pencil of light is shot to and swept from point to point over the field with the intent of penetrating the medium or in which the given field is extant. That is, the field is swept by progressive steps of the light pencil illuminated area from a starting point to a finish point.

It will be seen that at each spot on a translucent object field, which for brevity will be called a "picture," the amount of light which penetrates the medium will vary in intensity in direct proportion to the density of the medium and this medium, for one adaptation of the invention, will be considered as a "frame" of a translucent motion picture film strip. Therefore, there issues from the opposite side of a pencil swept frame a reduced pencil of light fluctuating in strength from the starting point of the sweeping motion to the finish spot on the frame. This reduced, fluctuating pencil which has sifted through the frame is a desired product.

An object of this invention is to pick up and use this fluctuating pencil to do any of several functions.

While it is within the concept of this invention that the pencil may be continuous in stream, from its source, to and from the picture it is here disclosed and an object that the original beam of light, from its source, is broken into a chopped stream of successive flashes of a predetermined cross-section area, and an object is to provide a method and means relative to this art whereby the periodicity of the stream flashes may be varied in accordance with available frequencies of electrical carrier bands which are used in transmission of the modulated pencil, after sifting through the picture, as later set forth.

Another purpose of the invention is to provide for the use of the modulated pencil flashes as a controller for the excitation of a light sensitive instrumentality whereby the fluctuating pencil may be translated into fluctuating electrical impulses in turn to be transmitted and used for various, desired purposes.

The invention is further a method and means for utilizing the generated, modulated and transmitted impulses in a receiver incorporating, in one adaptation, a means to make a picture or a motion picture strip, in replica, of the objective field picture from which the impulses were dominated; by the sifted light pencil.

Also, an object is to provide a method and means for so scanning or sweeping a given picture or subject as to obtain a good coverage of the field for reproduction purposes either by direct transmission of the impulses to a picture making receiver, or first to an impulse recorder and from it, as desired, to a picture making receiver.

It is an object, in a particular case, to provide a method and means whereby the impulses, controlled by a scanned picture frame at the scanning and impulse producing end of the apparatus, are, by the receiver or reproducing end of the apparatus, so directed to an unexposed film that from this film, when developed, as a negative it will be easily possible to produce a replica of the original picture. In other words it is an object to provide for an efficient coverage of the area of a given picture or frame in the first scanning or sweeping and in the negative to provide

for the reproduction from the received negative of a replica of the original, objective picture.

Aside from making a picture by a receiver, directly receiving and operative by the master impulses, means for recording the impulses for later regeneration mechanically, electrically or otherwise, for product producing function, the invention has for an object the adaptation of the impulses, original or reproduced, to the instant production of the replica of the original directly onto a projection screen for optical or manual observation.

Broadly, an object of the invention is to provide for an accomplish the wire or wire-less transmission of electrical impulses which are differentiated in power as determined by the intensity of successive light flashes in form of a train of pencils which are transmitted through a given medium, such as a picture film whose field is progressively swept by the train of pencils.

An object is to effect such transmission by employment of a motion picture film strip for the master control of a photoelectric cell serving to control supply of electric current to a suitable receiver.

An additional object is to provide a method and apparatus of utmost simplicity and low cost for achieving the desired results, with economy and efficiency, with speed limited only by the frequency of the wave band allowed or used.

An object is to provide a sending, scanning or sweeping assembly adapted to be installed between a conventional, focussed light source of fixed power and a conventional motion picture sound-track pick-up cell and amplifier unit or head, and to provide for use of the same type of scanning assembly in an interposed position between any conventional, optical sound recording unit and a receiving, unexposed film strip for reception of incoming impulses emanating at the sending assembly.

Also, an object is to provide a scanning assembly including a sender part having a line of dot-holes to send successive pencils in a side by side relation and which part cooperates with a "width" slot part or element, and which said parts have a relative rotary motion for successive presentation of pencils of light by sequential juxtaposition of the dot-holes to the width slot.

In this connection it is an object to provide for the optical reduction of a scanning width slot to the desired scanning line of a given size picture or frame.

An object is to provide a preferred form of scanning device including relatively movable parts each of which has light passing slots of suitable length and height and which have such relative position that as one part moves as to the other the two slots cooperate to form a small window or dot hole which shifts along the slots during part motion so that a continuous light pencil may pass if so desired in contrast to the passing of side by side pencils as will occur when a row of dot holes is used, as just above alluded to. Since the number of successive pencils in a given time is determined by the permissible frequency of the carrier band the two parts having light slots as above mentioned are preferred for the reason that an independent light stream-chopper, here provided, is the simpler device for change of the scanning set to meet an available carrier current.

It is an object to provide means for the coverage of a given picture from top to bottom as well as side wise, as just mentioned, and this includes provision whereby the number of scanning lines per picture is determined by a desired ratio of speed as between the travelling film strip, if used, and the speed of the preferably rotary part of the scanning assembly and hereinafter called the cylinder. That is to say the strip is operated at a desired speed of advance and the cylinder provided with a given number of spaced light slots, is speeded so that it will make a given number of revolutions in the time that one picture frame passes a focal point of the optical width determinant which is, in the following exposition, a reducer. The speed of the cylinder is determined by the band frequency available.

The invention consists in an art as set forth in the ensuing disclosure and has, with the above, additional objects and advantages, and many advancements, as hereinafter developed, and whose several method steps and the apparatus, and its construction, combinations, and details of means, and the manner of operation, will be made manifest in the description of the method and the herein illustrative embodiments of means; it being understood that modifications, variations, and adaptations may be resorted to within the scope, principle and spirit of the invention as it is more particularly claimed hereinbelow.

Fig. 1 is a diagram of a fragment of a motion picture film showing two contiguous frames each having a number of clear spaces and a number of lines, all spaces and all lines of equal height and the lines of one frame being offset as to the lines of the next frame so that if one frame is advanced to lap over the other, in frame register, the lines of one will register with the spaces of the other and thus make a 100% coverage of the picture area of one frame.

(In the drawings shading has no reference to color but is for contrast.)

Fig. 2 is a diagrammatic perspective showing a connected and magnified pair of frames having (arbitrarily) each seven, top to bottom, divisions of lines and clear spaces; those of one frame offset (alternated in a strip of picture film) and the frames being partially overlapped to show register of the lines (of exposure dots derived from a chopped pencil of modulated light) of one frame with the spaces of the other frame—to effect full coverage.

Fig. 3 illustrates a prime negative with frames formed of five (to aid illustration) divisions up and down, and the exposure lines of the frames relatively offset for full coverage if the contiguous frames are registered, and this figure shows the negative as being run with and for translation into a "lavendar print" film strip.

Fig. 4 illustrates the finished lavendar print being run with and for translation into a first exposure area of a "duplicate negative" (hereinafter called the "dupe") of a portion of each frame of the prime negative of Fig. 3; the black fields of the lavendar acting as a mask during this first exposure of the dupe frames.

Fig. 5 illustrates the reverse or uniform rewind of the lavendar print, hereafter called the "lav," together with the partly exposed dupe to bring the two strips back to the point of first frame exposure.

Fig. 6 illustrates the second running of the lav with the same dupe but with the frames of the lav advanced one frame length as to the first frame exposure step so that the offset picture (portion) of a pair of connected, contiguous lav frames will print into the space or area of the

relative frame, of the dupe, which was masked in the exposure step shown in Fig. 4, and so that the mask area of the lav will now mask the first exposed area of the dupe of Fig. 4.

Fig. 7 is a face of view of one complete picture frame (developed) which is one of the desired products of this invention.

Fig. 8 is a schematic diagram of a form of apparatus as adapted for making and transmitting image controlled, electric impulses.

Fig. 9 is an axial section, partly in plan, of the line sweeping rotary cylinder and synchronizing switch combination.

Fig. 10 is a schematic diagram of the impulse receiver and negative exposing assembly.

Fig. 11 is a diagram of the combined translating and transmitting assembly and the receiver assembly.

Fig. 12 is a diagram of an impulse recorder for impulse reproduction service.

Fig. 13 is a diagram of a modified form of line scanning cylinder with oblique rows of light passing holes.

Fig. 14 is perspective of a fragment of a rotary, line scanning reflector with a series of helical rows of oblique, individual pencil reflecting facets, for use in an aperture shell.

Fig. 15 is a perspective diagram showing a system in which the modulated current impulses are directly converted into a projected picture, with means to effect the composition of the alternate frame impulses into an instant image.

Fig. 16 is a diagram showing a system in which the projecting means of Fig. 15 is reversely used as a camera for the recordation of the scanned area of an objective on a record strip as a light track in combination, on the same track, of incidental sound track medium.

The translating sender

The picture film P, to be translated, is advanced in a head box **2** having a fixed shoe **3**, in which, in transmission use, is a lens **4** focussed on the usual or conventional photoelectric cell **5** of a current amplifier circuit **5'**. The film shoe **3** has a narrow, transverse, light-passing window **6** and focussed on this is an optical, ratio reducer **7** of any appropriate type.

Light from any suitable source **10** is intercepted by a chopping disc **11** having equal, annularly spaced slots **12** whence the light is delivered in the form of rapidly-successive, wide flat bars of about oblong cross-section due to the shape of the slots **12**.

The scanning or picture frame sweeping device includes a stationary shell and a rotary member fitting therein and having an annular series of successive, transverse kerfs or slots to register with and uncover, in successive fractions, a coordinate slot straight across a bearing wall of the shell on which the rotary member runs in close contact; the kerfs being symmetrically helical in the said member to effectuate such fractional shell slot uncoverage with the result that but a pencil of light will pass from the shell slot or aperture and this will traverse the aperture from end to end.

The present adaptation shows a rotary cylinder **13** provided with peripheral, equally spaced, equal slots **12** which are symmetrically helical as to the cylinder axis. The cylinder **13** is closely fitted and rotates in an outer shell **14** and this is provided with a light aperture **15** which is parallel to the axis of the cylinder. The obliquity of the cylinder slots **12** is such that only a small part thereof will register at one instant with the aperture **15**. The number and the pitch of the slots **12** is determined by the available frequency band and the speed of the master picture film strip P.

It is above stated that the slots **12** are oblique or angular across the periphery of the cylinder **13**, as between its axial extremities, and the walls of the slots **12** are as thin as is practical to secure minimum choke of light at the aperture **15**.

In transmitting a picture of the size of a standard motion picture frame, say .750 inch high, the film strip is moved at a practical rate of speed past the frame width window **6** of or at the feeder support **3**, and the scanning or sweeping cylinder **13** will be moved at such higher speed as may provide an effective coverage of the frame from top to bottom, or vice versa.

It will now be seen that there is here provided an optical means to reduce the width of the beam from the cylinder slots **12** to that of the frame width and the speeded cylinder **13** is a mechanical means for fixing a ratio of speed between the film strip motion so that desired line coverage from top to bottom of picture is effected.

From the chopping disc **11** light passes to a lens **18** transmitting the light as interrupted flashes of wide section to a reflector device **19** arranged in the axis of the cylinder, and held by a fixed mounting 19^x, and in an oblique position whereby to reflect as a wide, brilliant flash toward the shell aperture **15** which is covered by the cylinder **13** except for a small area of one of the oblique slots **12** as each slot is carried by the rotating cylinder **13** to the aperture **15**. Rotation of the cylinder causes light-pencil forming area of the slots and the aperture combination to sweep rapidly from one end of the straight and directly transverse aperture **15** to the other and to pass onto a reflecting prism surface **20** and thence upward to a reversing surface **21** to be sent to the reducer **7**. It is to be understood that the pencil of light is here bent in this manner to adapt the method and apparatus for use in a conventional motion picture sound head of which the usual strip feeder is employed.

Now this lateral shift of the pencil L of light traverses the picture frame F^1 from side to side in the form of a line of close dots, Fig. 2, in as close proximity as the carrier band will admit. A full or unbroken line of sweep by the pencil L is contemplated within the purview of this invention.

In the present disclosure the picture strip feed means is so geared to the aperture shutting cylinder **13** that one picture frame is first traversed by a given number of cross sweep lines, by the light pencil, as **1**, **3**, **5**, **7**, (for example) on a negative N, Fig. 2, which lines are spaced, top to bottom, frame B, a distance equal to the height (or thickness) of each line; there being seven divisions of lines and spaces, in this example, on the picture field frames. When the first master picture frame F^1, Fig. 8, has been swept to cover the given number of divisions, if the first line (compared to line 1, Fig. 2) is in the first division, of say seven, then there will be made four lines of picture sweep by the pencil L, Fig. 8, and three intervening blanks (as spaces **2**, **4**, **6**, Fig. 2, which represents a negative from such a divisioned picture which has been scanned and transmitted).

As the picture strip S is running at a constant speed the next succeeding frame **F2**, Fig. 8, comes to the aperture slot **6** and the first division, imaginary (as **8** of Fig. 2), will be a blank followed

by a line swept across the frame F2 and so on until this frame has been swept by the pencil L in three lines leaving four blanks (Fig. 2) as picture lines 9, 11, 13 and blanks 8, 10, 12, 14.

Thus the strip S has been used as a sifter for the strong pencil L of light through a pair of connected, adjacent frames F1 and F2 of the strip with the result that the pencil is sifted as bright, medium or dim in direct accordance with the density of the picture emulsion of the scanned frames. This modification or modulation of the strength of the pencil L is transmitted to the photoelectric cell 5, or its equivalent, and by this a modulated electric current is established in the sender circuit 5' and suitably amplified.

This current is in the form of successive impulses of a frequency determined, in this adaptation, by the speed of, and number of windows 12 in the chopping disc 11, or its equivalent, in the translating and sending apparatus. The frequencies of the chopped light are, in the first instance, governed by the carrier band.

Reference has just briefly been made to the divisions of lines and spaces (or blanks) 1 to 7 on frame B, and divisions 8 to 14, on frame A. These are the product of the conversion of the received, modulated impulses, at a receiver, into a photographic negative N. Having, at the sender, provided for and producing a number of electric impulses by the continuous advance of the frame F1, Fig. 8, in synchronism with the lateral sweep of the pencil L of light at the sweeping slot 6 to cover the frame with a desired number of spaced, sweeping lines to later effect the exposure of negative frame B, Fig. 2, by an identic number of exposure lines (as on the seven division basis—used merely for easy illustration), and by the chopping of the pencil L by the chopper 11, to secure frequency of impulses, it will be obvious that only a half, more or less, of a master picture frame F1 will develop on the relative negative frame B (at the receiver later described) and it will be clear that the picture lines 9, 11 and 13 of negative frame A will be exactly alternate with the picture lines 1, 3, 5, 7, of the leader frame B; these frames forming a related pair for purpose of disclosure only.

Fig. 2 illustrates that if the frames A and B are transversely folded on their connecting line then the picture lines 1, 3, 5, 7, of the frame B will register with the blanks 8, 10, 12, 14 of the frame A and make a full picture field coverage, but, of course, not in correct picture make-up. In chopped pencil impulse transmission a small blank area would occur between the picture spots along the picture lines across the frame.

The above disclosure is of one method for obtaining a full or nearly full coverage print from a series of image-controlled impulses from a motion picture strip S to a negative film where such negative is the product desired by the use of the modulated current of successive impulses.

The receiver

Referring to Fig. 10, the wired-circuit 5', if used, from the sender of Fig. 8, is connected to any desired amplifier AM and the received and amplified, picture-sifted, light governed current is transmitted to any suitable light valve V whence fluctuating light is passed to a reflecting device 19' arranged to spread the light onto the interior face of a rotary cylinder 13' having narrow, spaced light slots 12', helical in the cylinder and of a length to uncover, in successive portions, a directly transverse, coordinate aperture 15' in a fixed shell 14' in the receiver box, or housing R.

The master-picture-controlled pencil X of light from the valve V is passed, in this adaptation, to and from a reflector 20' to a pencil reducer 7' thence to an exposure line of an unexposed, negative-making, film strip N. The rotary cylinder 13' causes the light X to sweep laterally in spotted lines in synchronism with the sender action and the strip N is advanced in synchronism with the feed of the master picture frames F1 and F2, and so on, so that just as the picture frames are divided into say fourteen equal divisions so is the negative frame exposed on the basis of fourteen divisions; with the picture lines of the frame B, Fig. 2 alternated as to those of the frame A and all equally spaced and of equal height.

Synchronization of senders and receivers

The cylinder 13 of Fig. 8 is fixed on a shaft 25 having a gear 26 meshed with a driver 27 which is a part of a gear system driving the picture strip S. On the shaft 25 is fixed a wheel 28 having a contact plate 29 to be intermittently engaged once in each revolution by switch bars 30—31 of a circuit 32 which is excited periodically in rhythm with the rotation of the cylinder 13. The excitation of the circuit 32 is used in any desired manner appropriate to the function, to transmit a receivable and discernable signal to the receiving set R so that its attendant may place phases of a motor of the receiver in time with those of a motor of the sender T and thereby synchronize the operation of the rotary cylinder 13' with that of the sending transmitter T.

It will be understood that many receivers R will be able to pick up the picture-controlled, light-valve impulses from one translating and transmitting station.

Fig. 10 shows the circuit 32 as including a signal device, say a lamp 33, set in the receiver R in contiguity with a like device 34 of a synchronizing circuit 35 having a switch 36 closing on a contact plate 37 of a wheel 38 fixed to a shaft 39 of the receiver cylinder 13'. The attendant of the receiver observing the flashes of the two devices 33—34 will operate a phase timer 40 of a motor 41 which drives the gear train of the receiver, until it phases in synchronism with the sender motor 42, Fig. 11.

A feature of this invention is that the motor 42 is provided with a reduction gear system enabling the shaft of the cylinder 13 to be rotated in a given ratio of motor speed as will be determined to permit the sending attendant to utilize such a carrier frequency band as may be available to him at one or another locale of an event of which a motion picture has been made and is to be translated and transmitted in the said governed impulses of current. Such carrier band determines the number of light flashes in a pencil stream as cut by the geared-in chopping, rotary disc 11.

Impulse negative, lavender positive and duplicate negative and positive prints

Fig. 1 is merely a diagram to show closely spaced lines of an exposed pair of contiguous frames A and B with the lines of one frame offset as to those of the next to effect a full coverage if the frames are superposed as suggested in Fig. 2, where there is, for illustration, a hypothetical division of each frame into seven divisions from top to bottom with picture lines 1, 3, 5, 7, of frame B alternated with the picture lines 9, 11, 13

of the frame A. The lapped frames would show a full coverage of the field of either frame if the lines were themselves solid, that is, not derived from intermittent impulse current.

For practical illustration, Figs. 3 to 6, inclusive, show frames of a negative (exposed by the instant method and apparatus) and a lavender positive, and a dupe negative as all having five-sections from top to bottom of each frame. The pair of frames B^1 and A^1 of a negative N, Fig. 3, have their divisions marked 1 to 10, in two frames, and frame B^1 shows (developed) two spaced line picture parts 2 and 4, say of a gray bar on a white field. Frame A^1 shows by line 8 the residue of the bar because the rate of film speed as to the exposure shutter cylinder 13' is such that so long as the frames are imaginarily divided into a like number of sections then, with a given number of light slots 12' in cylinder 13', there will be made a series of spaced exposures on each frame and these will be in one-space or division offset relation in succession for the full length. The ten division basis of Fig. 3 well indicates such constant spacing and is used only for illustration of the printing process.

If the master picture film was exposed on a "still" subject no change in successive frame pictures is seen. If the master picture is of a motion subject then the successive frames will vary as determined by the speed of the subject (and of the film). Fig. 3 is of a subject in motion but motion change is not discernible, ordinarily, by the human eye in contiguous frames during normal projection speed.

Given an impulse-current, translated negative strip as of Fig. 3, the next step is to make a contact exposure to produce a lav print or positive strip LP in which the bar shows clear and the field, for white, is black. Next, this lav strip is run with an unexposed film strip DN to make a first exposure which will produce (developed) the dark part for the bar, relative to the frames B^1 and A^1, carried through the lav print from the negative N, and the white field will show in the relative dupe frames. In this first exposure the black part of the lav masked the dupe negative DN and protected that area from exposure.

Now the two film LP and DN are re-wound that is reverse wound back to their reels and at this time the lav LP is stepped ahead one full frame, that is, the frame B2 is caused to lap the exposed frame A^1 of the lav LP and in such position the masking black of the lav LP covers the first exposed emulsion whilst the clear picture of frame B2 will be in exposing relation to that part of frame A^1, Fig. 6, not exposed in Fig. 4. Fig. 6 shows the fully exposed frame obtained by the first exposure of Fig. 4 and the second exposure of Fig. 6.

When the full area of the successive frames of the lav LP of Fig. 6 have been exposed by the second run of the dupe with the lav in the advanced position of the lav the exposed dupe DN is developed and fixed and as many positive prints PP, Fig. 7, may be made as is desired, and will show the gray bar on a white field. The change of the position of the strips by one frame height is too small to effect the projection-picture use of the ultimate positive PP.

Recordation

From the process here described for producing electric impulses of a receivable nature, a further advance is to pass such impulses into a recording machine having an electrically controlled recording means, a stylus ST, Fig. 12, for instance. By such a machine an efficient record RE is produced and it may be used at any time at any institution having a means to translate the record back into electric impulses for use in a manner above set forth or as may be desired.

Thus the invention provides for the change of film speed to translate the light frequencies of an image, in their variable strengths, into electrical impulses and to control these impulses so that they can be transmitted on different carrier bands: for instance to transmit over ordinary telephone line current of approximately 3,000 frequency by controlling the speed of the motion picture film being light swept and allowing a frequency of only 2,000 for the carrier band. It provides for transmission over long distance wired line with a higher frequency of approximately 5,000 by increasing the speed of the film being pencil swept so as to increase the impulse frequencies and in that way the line time. It enables impulse recordation on a phonograph or other suitable record device which requires up to 9,000 frequencies, by speeding up the film advance to acquire that rate of impulse flow.

The invention provides means to obtain as much detail as possible of an image with as small a frequency band as possible. The optical and the mechanical scanning attachment offsets the scanned areas from one another by alternating or interlacing the parallel scanning lines in alternate frames and also the horizontal, scanned areas. Thus only one-half of the area of each motion picture frame is actually pencil swept thereby requiring only one-half of the amount of carrier frequencies, the following frame using the other half and so on in the film series.

After the receiving emulsion film strip has been exposed and developed, the film, if a positive reception, or a print of it, if the exposed strip makes a negative, may be run at thirty-two frames a second and the persistence of vision of the image will be effective to establish a satisfactory mental picture: at this speed two successive frames with said alternate lines of scanning will make a good composite picture to the eye of the observer.

The present apparatus and method are of use for the making of news reels as next explained. A camera-man may be at the location of an event of notice and may take a motion picture of it. With the developed picture and having a sender of this invention, and having any type of telephone line, or short wave radio, or other means of electrical communication available, after ascertaining the carrier band of the system, may set the sender or transmitter at a speed equivalent to the carrier band so as not to exceed its frequency. He may then contact as many agencies as desired having suitable receiving apparatus, and then proceed to transmit the picture controlled current impulses. At the receiving stations an emulsion strip will be exposed and developed and subsequent prints produced, in a very short time, ready for projection screen reproduction of the original event, without any change, for instance, in motion picture routine.

For instantaneous reproduction take as an example the scanning of a 16 mm. frame, which is .380 by .284 inches in area. A 60-line picture frame would require 664 pencil light flash dots altogether and for clear projection would have to be run at 16 frames per second, requiring 10,324 dots or scanned areas per second to be converted into a like number of picture modulated cur-

rent impulses (frequencies) per second. By using well known types of receivers and amplifiers it is possible to produce up to 20,000 frequencies. Therefore by using only 10,324 frequencies, well under the carrier band, there is also room for sound; which requires approximately 8,000 frequencies. In reproducing, at a receiver, two pick-up needles are used to obtain the optical effect offset and to reproduce a picture of 120 line coverage. To accomplish this one needle is place one picture frame behind the other and is operated through a separate amplifier unit; each needle controlling a suitable light valve or other adaptable instrument. By matched optical systems these two light sources, controlled by the offset frame needles, may be registered optically on a screen. The optical rays are distributed in their respective positions by mechanical means in synchronism thereby producing a composite image on the screen and having, in appearance, 120-line coverage and which may be of different sizes, depending on the throw and the optical means used.

A system is shown in Fig. 15 in which modulated-current impulses (derived from alternate, master picture frames) are sent to a pair of light valves V' focussed on respective, coaxial, right hand and left hand pitch helical reflectors 19a fixed on a shaft 50 having a pinion 51 which drives a larger gear 52 on and for suitable decrement in speed of a shaft 53. The shaft 53 has suitable cams 54, one for each of synchronously oscillating, respective reflectors 55 which are focussed by respective lenses (one only shown) onto a projecting screen PS. The reflectors 19a are timed to rotate a given number of times to one revolution of the shaft 53 so that in one revolution of reflectors 19a a pencil of light, from each, is swept across each reflector 55, thence to lenses 56; the cams 54 acting to tilt the reflectors 55 at a given speed to change the line of sweep progressively from top to bottom of the respective reflectors 55 so that their faces are swept line by line; the one in alternate coverage as to the other, the lines of sweep on each being spaced, as for example in Fig. 1. One reflector 19a acts to project light lines relative to impulses from one picture frame, A, Fig. 1, whilst the other reflector 19a acts as to impulses from frame B, to obtain full image field effect: that is, the composition of the two-picture-frame train of impulses into a composite picture thus directly produced on the projection screen PS. This system provides apparatus and means for the instantaneous conversion of picture-current impulses into a projected image without the indirect medium of the positive print PP of Fig. 7.

The system of Fig. 15 may be reversely used as a camera, and by it an object viewed may be used to modulate electric circuits including photoelectric cells 5a (one shown) or their equivalents, Fig. 16. In this adaptation an object O is viewed by two lens sets 56 each focussed on a reflector 55 (paired as in Fig. 15) and each sending an image light beam to its respective, rotary reflector 19a (one shown). Each rotary reflector 19a deflects the image light to a rotary chopper 11a and thence to its cell 5a whose current is amplified by amplifier AM for adaptable use. Plural converting sets, as form lenses 56 are for the purpose of object field coverage by alternate line scan. This adaptation enables the simultaneous making of conventional sound track or sound record ST on a film strip SP, of narrow dimension, say 16 mm. by a standard sound recorder SR having a microphone M at the object scene O, say of a gunnery target, which is viewed by the camera systems 56 synchronously with the exposure of the strip SP to the light pencils from standard sound record sets SR', one of which is connected to each amplifier AM of a convertor train from respective lenses 56.

Instead of a light chopping disc 11 the light from the source 10, Fig. 8, may be cut into flashes by a cylinder 13a, Fig. 13 having oblique lines of holes 12a, which holes successively, along their lines, register with the aperture 15, when adapted in such a combination, and the successive lines of holes being in staggered relation so that the holes of one line of scan will register with the blind spots between the holes of the next preceding line, to effect field coverage.

Successive flash pencils may also be obtained by the use of a cylinder having a plurality of rows, of helical form, of individual reflectors 19b set at a 45° angle to the axis of the cylinder 19c, Fig. 14 and in such a position, when adapted in a rotary cylinder 13, Fig. 1, as to successively cast a pencil of light L toward the aperture 15 of the shell 14.

The system of Fig. 15 involves an oscillating reflector 55. To make a composite projected picture, from a picture-frame dominated electric current, it is understood that two sets of reflectors will be coordinated (as in Fig. 15) to compose current impulse pencils of light as from alternate picture frame lines (Fig. 1).

What is claimed is:

1. In a system of the class set forth, light beam controlling means including a source of light, a cylindrically bored shell part having a light slot through its bore wall and a barrel part movably fitting in and close to the shell and having in its cylinder wall a series of light slots; the shell and the barrel being relatively movable and the slots of one part being angular as to the slot of the other and cooperating therewith to form a travelling light aperture for light from said source to the exterior of the shell.

2. In a system of the class described, a source of light, a cylindric shell having a light slot parallel to its axis, a barrel fitting turnably in the shell and receiving light from said source and having oblique slots to pass it to the shell slot; said means and the shell slot cooperative to emit the light as a laterally sweeping pencil.

3. Apparatus of the class described and including a modulated current receiving means for concurrently projecting beams of light to a medium and including a plurality of current motivated, light valves, time coordinated helical reflectors to which the beams are respectively directed and which function to project the beams in sweeping action, second plane reflectors having timed motion coordinated with the first reflectors, and means focussing the light from the second reflectors at one time onto different spots on the said medium.

4. Apparatus of the class described and including means to produce a record by concurrent use of a plurality of modulated light beams translated from a common viewed object and including lenses to focus on the object at one time, light valves, joined helical reflectors passing constant axis beams from the lenses to the light valves, and means controlled by the said valves for impressing the desired record of light from the lenses onto a record medium.

5. In a system of the class described; lenses

for viewing a common objective, reflectors onto which the lenses focus light from the objective, second reflectors receiving light from the objective reflectors and arranged to project different light pencils from the objective, means to motivate the objective reflectors so as to concurrently send light from the objective lenses to the second reflectors, light sensitive current control devices, one for each second reflector, said second reflectors operative to send pencils of light to said devices, and choppers for cutting the light pencils coming from the second reflectors.

6. In a system of the class described; a coaxial pair of right and left hand pitch helices rigidly connected for co-rotation unidirectionally and having reflective side faces, means for casting pencils of light which are parallel to the helix axis onto faces of the helices from each of which they are cast in parallel lines all in a common plane, one line at a time from each helix; second, plane reflectors to receive the parallel shifting pencils from respective helices and the plane reflectors being set to interlace the relative groups of pencils from the helices, and focussing means having a common focussing plane for receiving and transmitting the pencils of light from the second reflectors.

7. The system of claim 5; the first named reflectors being synchronized with the second reflectors.

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