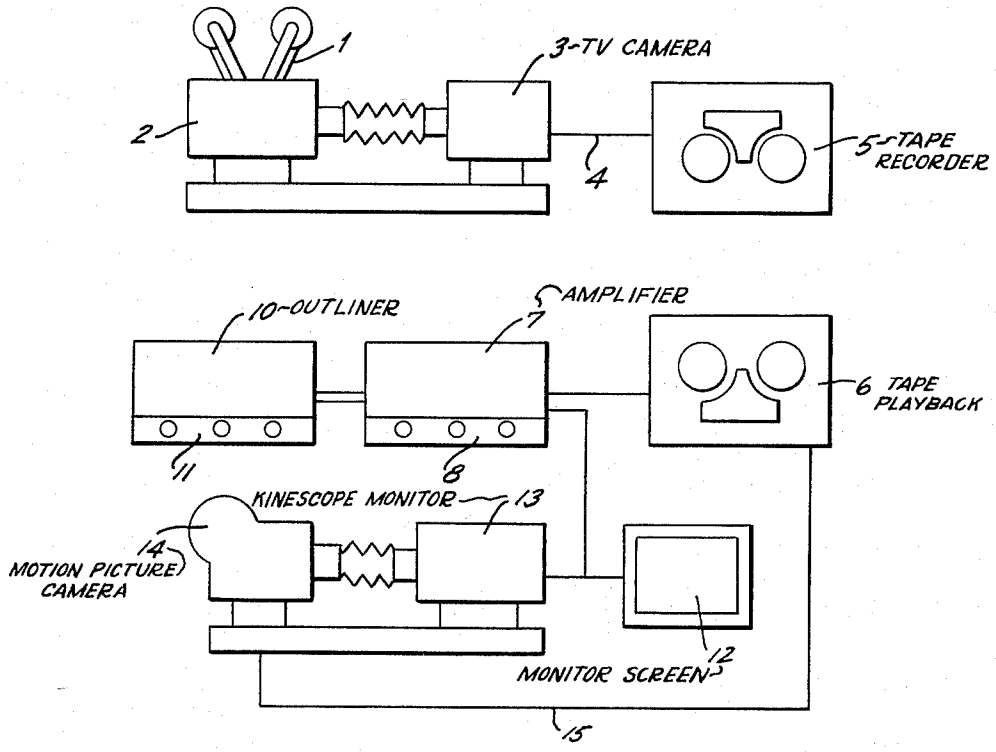
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METHOD AND APPARATUS FOR PRODUCING ANIMATED CARTOONS

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FIG. 1




INVENTOR.
LEON H. MAURER

BY Hans Berman

AGENT

June 22, 1965 L. H. MAURER 3,190,955

METHOD AND APPARATUS FOR PRODUCING ANIMATED CARTOONS

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FIG. 2

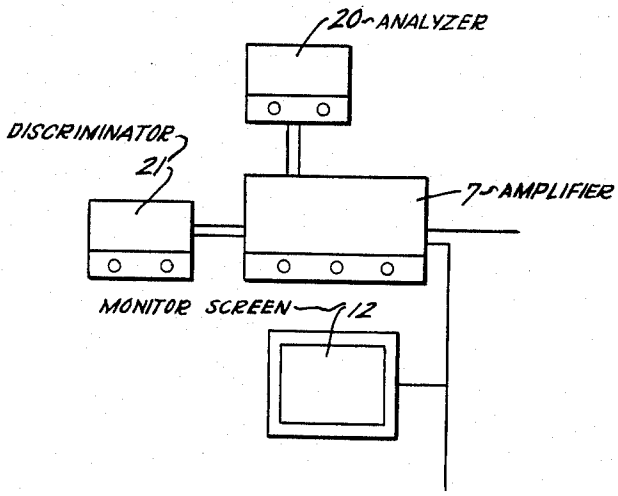
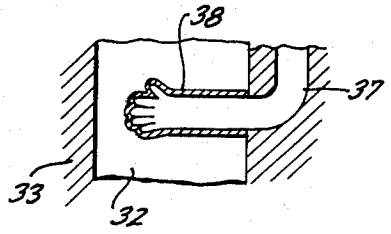



FIG. 4



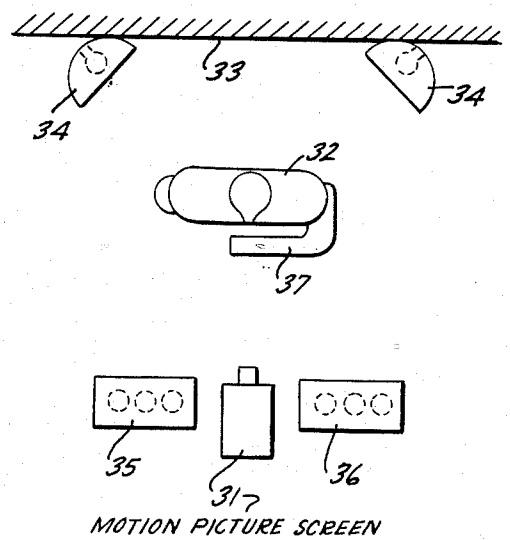




FIG. 3

INVENTOR.
LEON H. MAURER

BY Hans Berman

AGENT

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# METHOD AND APPARATUS FOR PRODUCING ANIMATED CARTOONS

Leon H. Maurer, New York, N.Y., assignor to Westworld Artists Productions Inc., New York, N.Y.

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6 Claims. (Cl. 178—6)

This invention relates to the production of motion pictures. It is more particularly concerned with a process of automatically performing important steps in the production of animated cartoons, and with apparatus for carrying out these steps.

Animated cartoons are characterized by an intentional lack of realism which gives a freedom of artistic expression not available with the usual photographic processes of making live action motion pictures. Within this framework of reduced realism, it is still necessary that movements of human figures be smoothly and credibly represented. A high level of artistic achievement is necessary for drawing successive frames of an animated cartoon in such a manner that the projection of the resulting film produce the illusion of movement in a screen image.

The production of animated cartoons has become extremely expensive when each frame is drawn individually. In order to reduce the cost, the work of the most highly skilled artists has been limited to drawing the outlines of the moving figures, and the task of coloring the outline drawings is performed by less expensive personnel. The colored outline drawings which are of a size substantially greater than the standard 35 millimeter film frame are transferred to the film by mechanized photographic processes.

If the outline images of the several frames are produced automatically, the desired lack of realism can be adequately maintained by coloring and other relatively inexpensive hand operations. Purely photographic processes have been developed which permit an outline film to be produced from a live action film taken under suitable conditions. These photographic processes involve repeated transfer of images from an original negative to high contrast copy films and simultaneous printing of two superimposed images of unequal size. The rim area of the larger image which projects beyond the smaller image eventually is reproduced as an outline picture.

The known photographic processes based on the principle briefly outlined above rely on very precise alignment of the two simultaneously copied unequal images. Such alignment is difficult to achieve with photographic film the dimensional stability of which is limited, and misalignment if any is not readily observed and controlled during printing since a latent image is produced which becomes apparent only after laboratory processing.

A characteristic feature of animated cartoons is the possibility of distortion of selected objects and other unrealistic effects. Such effects are capable of being produced to some extent by optical or other photographic means, but the results achieved cannot be judged adequately until a print is developed. The photographic processes for transforming a live action film into an outline film thus are hampered by registration problems, by the unavoidable delays inherent in the development of film samples, and the difficulties involved in maintaining uniform operating conditions without the possibility of convenient inspection of the outline film as it is being printed.

It is the primary object of this invention to provide a method of producing an outline film from a live action film in which no photographic laboratory processing is necessary to judge the success of the transformation of the live action picture into an outline picture.



Another object is the provision of a method and apparatus which provide a preview of the outline picture to be produced before photographic emulsion need be exposed.

A further object is the provision of a method and of apparatus for performing the method which permit visual observation and modification of a latent outline image on a photographic emulsion while the emulsion is being exposed.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings in which:

FIG. 1 diagrammatically illustrates preferred apparatus for performing the method of the invention;

FIG. 2 shows a modified detail of an apparatus generally similar to that of FIG. 1 in diagrammatic representation;

FIG. 3 is a plan view of an arrangement for taking a live action film intended to be converted to an outline film by the method of the invention; and

FIG. 4 shows a detail of the arrangement of FIG. 3 in front elevation.

Referring now to the drawing in detail, and initially to FIG. 1, the several units of an apparatus for performing a preferred embodiment of the method of the invention are shown in diagrammatic representation.

A black-and-white 35 mm. film 1 of a live action scene is fed to a projector 2 interlocked with a television camera pickup 3 which scans the image projected by the projector 2 on an internal screen (not shown) and produces a correspondingly modulated primary electrical signal. The signal is transmitted by a conductor 4 to a television tape recorder 5 which transforms the record of the original photographic film 1 into a magnetic tape record.

At any desired time, the tape record is fed to the playback machine 6 the outline of which substantially reproduces the primary pickup signal. The playback machine 6 is connected to a video amplifier 7 equipped with a set of controls 8 which permit the response of the amplifier to be varied in the usual manner for brightness, contrast, and dimensional properties and proportions of the output image.

The video amplifier 7 is equipped with an outliner circuit 10 which is shown to be mounted on a separate chassis and to have its individual controls 11, but it will be appreciated that the outliner circuit 10 would normally be combined with the video amplifier 7 on a single chassis, with the controls assembled on a single apron of the chassis or on a single control panel.

The outliner circut 10 may be of a known type such as that described by R. H. Hallows in the Journal of the SMPTE, vol. 70, pages 23–26. The circuit includes a standard pentode amplifier tube which is operated "below the knee" of the plate characteristic to obtain a reversal of transfer characteristic slope. Selected amplitude increments of a video signal are projected over this reversing characteristic and the remaining video portions not in the immediate vicinity of the reversal are deleted. The outliner amplifier 10 thus has an "off" response to signal levels both higher and lower than the selected input level, and an "on" response to signals corresponding to a selected brightness of the corresponding portion of the original photographic film 1. The output of the amplifier 7 as modified by the outliner circuit 10 is fed to a control monitor 12 which shows an outline image corresponding to the original photographic image as modified by the controls 8, 11. The lines of the outline image trace those portions of the original image which are within the selected brightness range. This range may be shifted by

the controls 11 toward or away from maximum picture brightness.

The output of the outliner amplifier 10 is also fed to a television kinescope monitor 13 directly coupled with a photographic motion picture camera 14 and synchronized with the tape recorder 6 to produce one or several frames of 35 mm. outline film corresponding to each frame of the original black-and-white film 1. The synchonization of the motion picture camera 14 with the tape playback machine 6 may be achieved in any desired manner. A conductor 15 is shown to indicate a synchronization connection, not otherwise illustrated, between the playback machine 6 and the camera 14.

The outline film is developed and employed in a cel enlarger projector in the usual manner to produce positive outline cels corresponding to the individual frames of the original black-and-white film. The term "cels" is employed in the manner conventional in this art to designate photographically or otherwise produced transparent images substantially greater than the frames of standard 35 mm. film to which they will eventually be transferred by photographic processing.

The outline cels obtained by magnification of the outline kinescope film are touched up, colored as desired, and combined with background and artwork for conventional shooting of a negative color film in a standard animation camera. A release film is produced from the negative as is usual.

It will be appreciated that the apparatus illustrated in FIG. 1 and described above may be modified in many respects. The primary signal fed to the video amplifier may be obtained directly from a video pickup taking a live scene. The pickup may record a live action scene on a tape which is then fed to the playback machine. Alternatively, the optically produced image of the film 1 may be scanned by the video camera pickup 3 the signal of which is directly fed to the video amplifier 7. Other arrangements in which pickup means transform an optical image directly or indirectly into a primary signal to be fed to the video amplifier 7 and to the outliner amplifier 10 will readily suggest themselves to those skilled in this art.

The outliner circut 10 which is sensitive to an input signal corresponding to a particular brightness value of a portion of the original optical image may be replaced by an outliner circuit responsive to a predetermined brightness difference between successively scanned portions of the optical image from the film 1.

Such an outliner circuit is diagrammatically illustrated in FIG. 2 to include an analyzer 20 of known circuitry which produces an output pulse whenever the output signal of the amplifier 7 varies. The output signal of the analyzer 20 thus varies depending not on the magnitude, but on the rate of magnitude variation of the output signal of the video amplifier 7. The output signal of the analyzer 20 is fed to a discriminator 21 which constitutes a high pass filter. It suppresses those portions of the output signal of the analyzer 20 which are below a minimum level set on the controls 22 of the discriminator 21. The output of the discriminator 21 is fed to a monitor screen 12 and a kinescope monitor 13 in the manner described above in connection with the apparatus shown in FIG. 1 to produce a visible outline image in which lines appear where there was a corresponding sudden transition from an area of relatively great to an area of low brightness or vice versa on the film 1. While the analyzer 20 and discriminator 21 have been illustrated as independent units, they will normally be combined with the video amplifier 7.

FIG. 3 shows a representative arrangement employed for photographing human actors or other moving objects in a top plan view. The camera 31 is loaded with high contrast black-and-whie motion picture film 1. The actor 32 is preferably dressed in white or very lightly colored garments and his make-up is chalk white. He moves against a black background 33 since it is desired to obtain mainly overall outline cels of the body. Dark accent stripes and other dark overlays may be applied to his clothing and to his features where corresponding lines are desired in the final product.

Lighting is applied by two groups of lamps. A first group 34 is arranged behind the actor and laterally offset from the line of sight of the camera. This group provides particularly great contrast between the background and the rim of the moving figure. A second group 35 of lamps 36 is arranged to provide flat lighting parallel to the camera axis. The negative film produced by this arrangement has no detail in the black background and very little detail in the white moving figure except for the aforementioned accent stripes.

There is, however, some gradation in the white where portions of the body such as the arm 37 are placed between the camera 31 and another body portion. FIG. 4 shows a body portion of the actor 32 with his arm 37 placed before him. The arm casts a penumbra 38 due to the spaced arrangements of the individual lamps 36. It is very desirable to reproduce this penumbra, light though it may be, by an outline in the ultimate outline cel. If this cannot be done, it would be necessary to show the outlines of the lower arm and hand in the cel by drawing them individually.

The controls of the video amplifier 7 and of the outliner amplifier 10, or those of the discriminator 21 permit the relatively small differences in brightness due to the penumbra 38 to be reproduced properly on the kinescope monitor 13 in the form of an outline. The adjustments required are fairly critical, but they can be readily made because of the provision of the monitor screen 12. In the arrangement illustrated in FIG. 1, the corresponding portion of the television tape record is run through the playback machine 6 repeatedly until the controls 11 are properly set to produce the desired image on the monitor screen 12. Only then is a film exposed in the camera 14.

It may be possible to achieve similar results in a purely photographic arrangement employing optical means and special laboratory processing for transforming the original black-and-white film into a sequence of outline images, but it would hardly be practical. The time involved in taking and processing sample strips is sufficiently long to alter the critical test conditions from one take to the next. It is apparent that rerunning a television tape through the playback machine 6, or rerunning the black-and-white film 1 through the projector 2 where the television camera pickup 3 is directly connected to the video amplifier 7 is very much simpler, faster, and more economical than repeatedly exposing and processing portions of a film. The method of the present invention thus provides the first practical method of inspecting and editing outline film produced from a live action film while the image is being transferred from one film to the other.

The familiar controls 8 of the video amplifier 7 permit many special effects to be produced simply and conveniently that are not readily available with purely photographic methods. The size of the outline image may be reduced or enlarged either in its entirety or selectively as is well known. Linearity controls of conventional type permit distortions of the image which give to the final product one of the characteristic features of the original hand drawn cels. The flexibility of the system is further enhanced by the ease with which any desired effect may be first tried without actual exposure of sensitized film and without the assistance of the processing laboratory. The director has full control over important aspects of the production by merely manipulating a few control buttons. He can rehearse special effects and repeat the rehearsal as many times as needed within a short period with a minimum of expense and without losing any time while waiting for the results of his work to be made visible.

It is a particular advantage of the method of the invention that photographic laboratory processing work is

limited to the routine processing of the original black-and-white film and to the equally routine processing of the final outline film from which outline cels ready for touch-up and coloring may be produced by conventional automatic machinery.

It should be understood, of course, that the foregoing disclosure relates to only preferred embodiments of the invention and that it is intended to cover all changes and modifications of the examples of the invention herein chosen for the purpose of the disclosure which do not constitute departures from the spirit and scope of the invention set forth in the appended claims.

What I claim is:

1. In a method of producing a motion picture film of the animated cartoon type, the steps of producing an optical image of a live action, said image having a plurality of portions differing in brightness; sequentially scanning said portions; producing a primary electrical signal sequentially modulated according to the brightness of the sequentially scanned image portions; generating an electrical outline signal selectively responsive to the modulation of a portion of said primary signal corresponding to a predetermined brightness property of said optical image and deleting the remainder of said primary signal, said remainder corresponding to a brightness property different from said predetermined property, said property being selected from the group consisting of a brightness difference between successively scanned portions of said image and a brightness value of a scanned portion; transforming said outline signal into a visible outline image; controlling the response of said outline signal to said modulation to modify said outline image; and producing a photographic record of said modified outline image.

2. In an apparatus for producing an outline motion film, in combination, pickup means for scanning an optical image and for generating a primary electrical signal modulated responsive to the brightness of successively scanned portions of said image; amplifier means in circuit with said pickup means for generating an outline signal selectively responsive to the modulation of said primary signal corresponding to a predetermined brightness difference between successively scanned portions of said image, and for deleting the remainder of said primary signal, said remainder corresponding to a brightness difference other than said predetermined brightness difference; monitor means in circuit with said amplifier means for transforming said outline signal into a visible outline image, said amplifier means including control means for controlling the response thereof to said modulation whereby said outline image may be modified; and recording means for recording said visible image.



3. In an apparatus for producing an outline motion film, in combination, pickup means for scanning an optical image and for generating a primary electrical signal modulated responsive to the brightness of successively scanned portions of said image; amplifier means in circuit with said pickup means for generating an outline signal selectively responsive to the modulation of said primary signal corresponding to a predetermined brightness value of a scanned portion, and for deleting the remainder of said primary signal, said remainder corresponding to a brightness value different from said predetermined brightness value; monitor means in circuit with said amplifier means for transforming said outline signal into a visible outline image, said amplifier means including control means for controlling the response thereof to said modulation whereby said outline image may be modified; and recording means for recording said visible image.

4. In an apparatus as set forth in claim 2, said amplifier means including analyzer means in circuit with said pick up means for producing an output pulse of a level responsive to the rate of magnitude variation of said primary signal; and discriminator means connected to said analyzer means for suppressing the pulses produced by said analyzer means which are below a predetermined level, the remainder of said pulses constituting said outline signal.

5. In an apparatus as set forth in claim 2, said remainder corresponding to a brightness difference smaller than said predetermined brightness difference.

6. In an apparatus as set forth in claim 3, said amplifier means including amplifier tube means having a predetermined plate characteristic including a knee, circuit means connected to said tube means for operating the latter below the knee of said plate characteristic, and respective circuit means for operatively connecting said tube means to said pickup means and to said monitor means.

**References Cited by the Examiner**

UNITED STATES PATENTS

2,073,370 3/37 Goldsmith ---------- 178—6.7

DAVID G. REDINBAUGH, *Primary Examiner.*

E. JAMES SAX, *Examiner.*