

May 30, 1939.

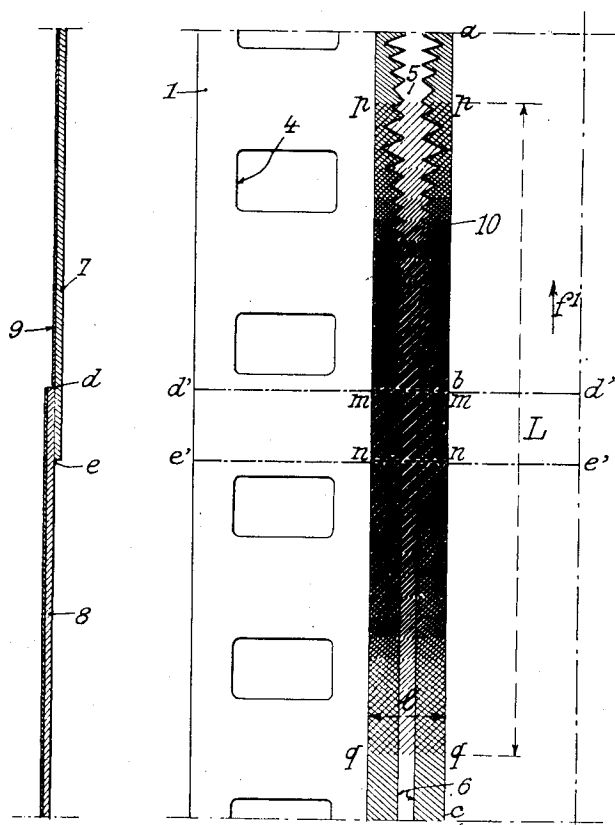
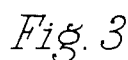
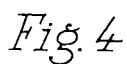
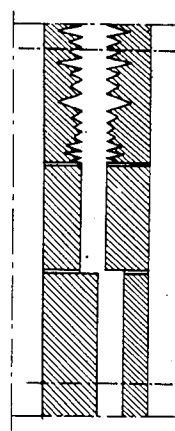
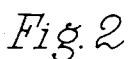
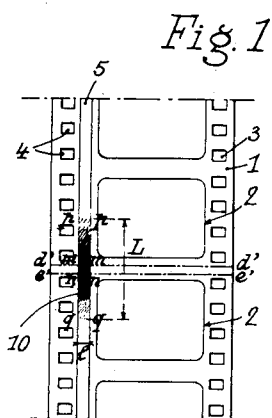
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2,160,252

METHOD AND APPARATUS FOR THE ELIMINATION OF DEFECTS IN SOUND TRACKS

Filed Aug. 29, 1936

4 Sheets-Sheet 1



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METHOD AND APPARATUS FOR THE ELIMINATION OF DEFECTS IN SOUND TRACKS

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4 Sheets-Sheet 2

Fig. 7

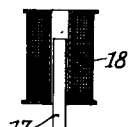


Fig. 6

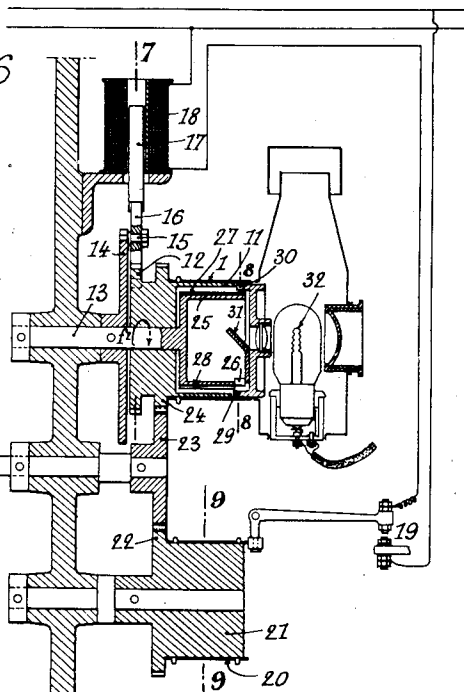


Fig. 8

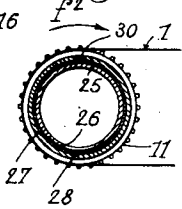


Fig. 9

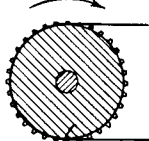


Fig. 11

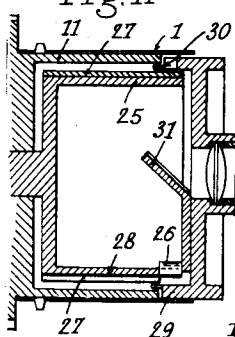


Fig. 10

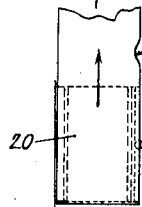


Fig. 12

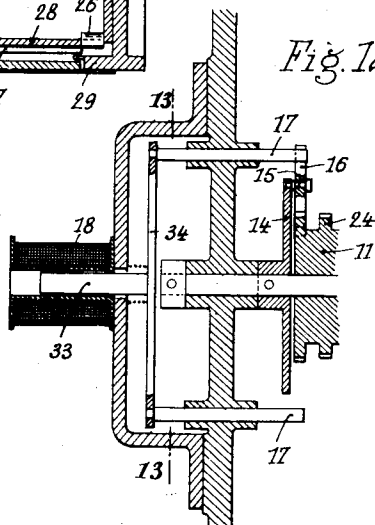
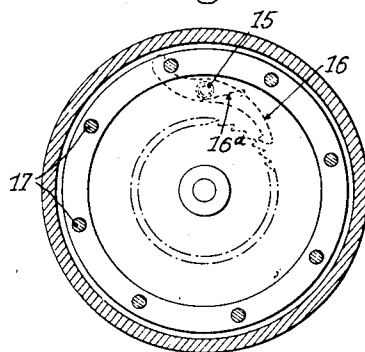


Fig. 13



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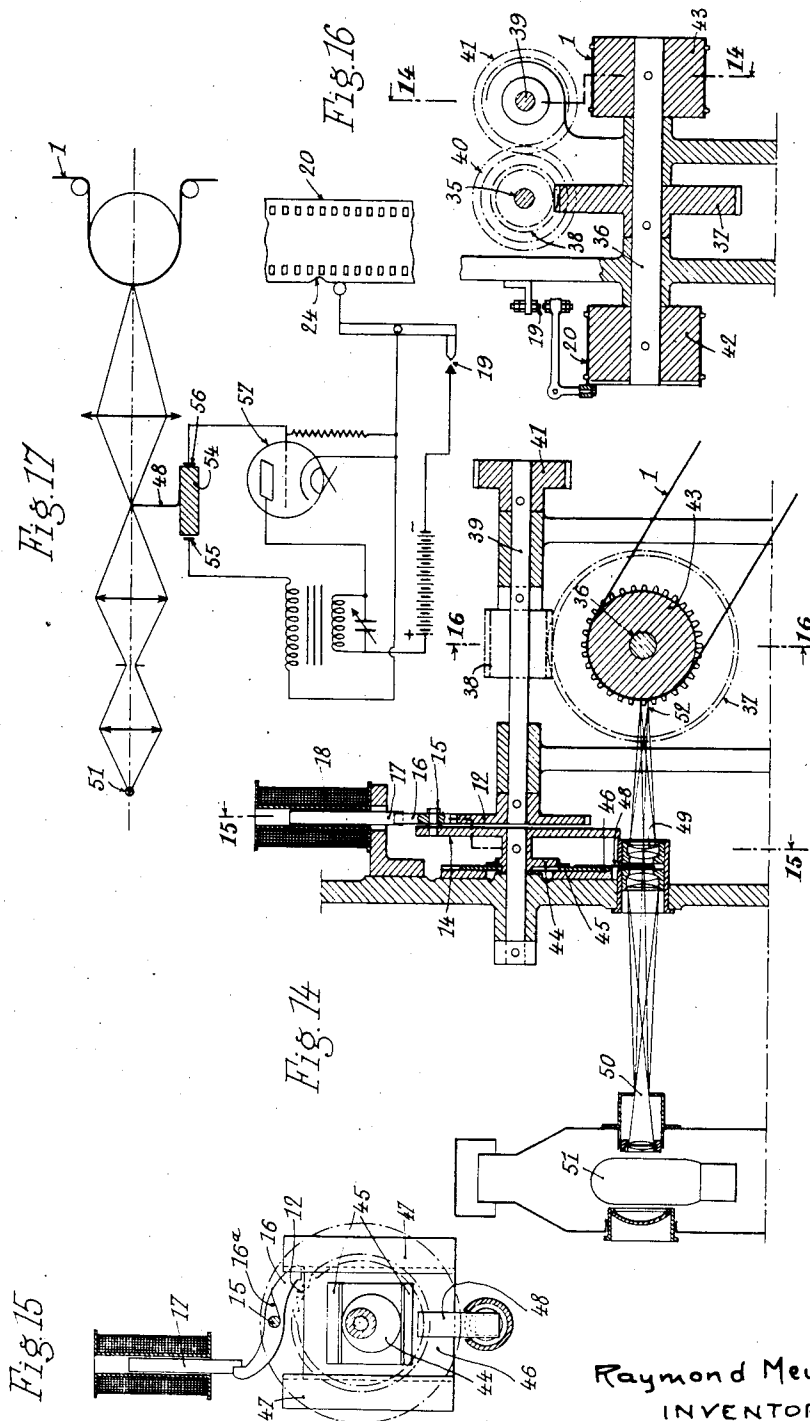
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METHOD AND APPARATUS FOR THE ELIMINATION OF DEFECTS IN SOUND TRACKS

Filed Aug. 29, 1936

4 Sheets-Sheet 3



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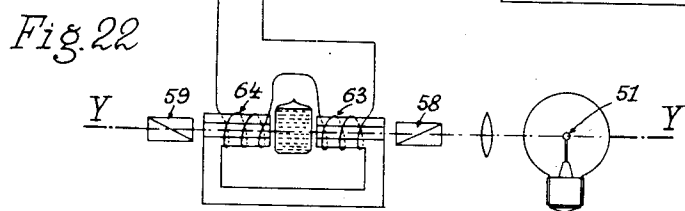
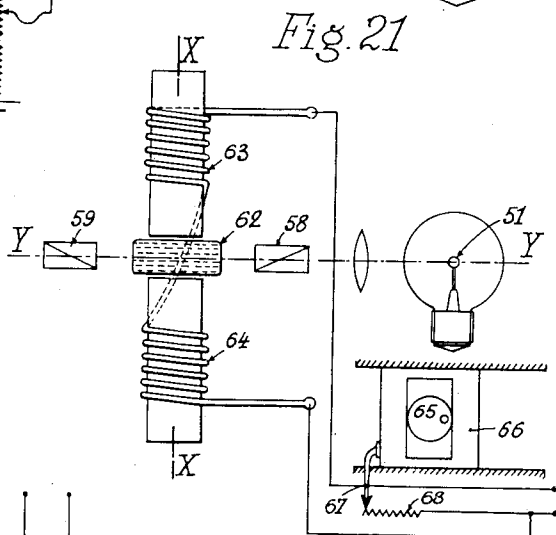
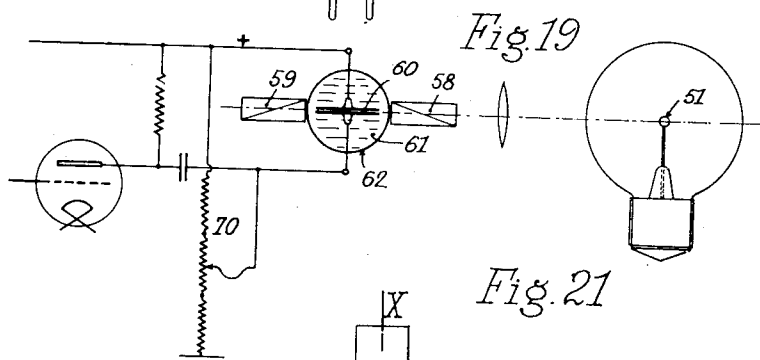
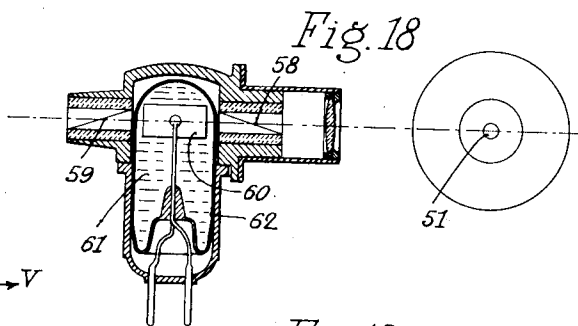
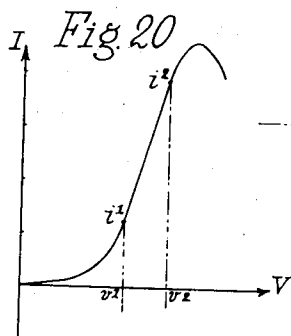
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METHOD AND APPARATUS FOR THE ELIMINATION OF DEFECTS IN SOUND TRACKS

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4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

2,160,252

METHOD AND APPARATUS FOR THE ELIMINATION OF DEFECTS IN SOUND TRACKS

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Application August 29, 1936, Serial No. 98,606
In France September 13, 1935

8 Claims. (Cl. 179—100.3)

This invention has for its object a method for the elimination of certain defects or anomalies in sound tracks, in order to improve the sound reproduction, as it is well known that in an absolutely general manner, any anomaly in the transparency of sound track will be manifested by a parasitic noise during the audible reproduction of the record forming the sound track.

On the other hand, when proceeding to copy the sound negatives by the photographic process, all the anomalies, irregularities or defects in the negative record will be shown in the positive by corresponding anomalies, irregularities or defects, which, as above mentioned, are as many sources of parasitic noises. This is of special importance when copying acoustic motion picture negatives, which always consist of comparatively short sections, assembled at the ends by cementing.

In this particular case, when making the photographic copy, the two edges of the cemented part produce two white lines in the positive, and when traveling in the sound reproducer they will give rise to a special parasitic noise, known by the name of "clacking".

A known method is used for eliminating the parasitic noises due to the white lines on the sound tracks by a suitable modification of this sound track at the point corresponding to each defect.

The nature of this modification will evidently depend upon the character of the sound track to be corrected.

In the motion picture industry, this modification usually consists in suppressing the two aforesaid white lines, or any other defect, by the use of an operation, which for the sake of simplicity in the description will be hereinafter termed "covering".

Hitherto, in order to obtain this covering in practice, the operation consists, either in a covering of all the positives directly and individually after making the copies or in a covering of the negative before making the copies, in order to replace the copy of the defect by the copy of the modification by which it is to be eliminated.

When this modification is applied individually on each positive, the covering generally consists in concealing the defect by means of a varnish which is applied directly to the positive at the place of the defect and according to a suitable outline.

When the modification is made upon the negative before the copying, it is feasible to apply a varnish to the negative in such way that the place on the negative which is covered with the varnish will be shown, when printed on the positive, by a more transparent place, or to perforate the negative, in which case the perforation is shown on the positive by an opaque region.

The process based upon the use of a varnish,

applied to the positive or to the negative, is a troublesome operation. On the other hand, it is quite difficult in this case to give an exact predetermined form to the covering, as the varnish will spread out and the exact chosen form is difficult to obtain.

When used for positives, the process is long and expansive, as the operation must be repeated for each copy. When used for negatives, it has the drawback of producing a covering in the shape of a clear part, thus replacing the "clacking" by the general "deep sound" which is due to the transparent places.

The process which makes use of a perforation of the negative will damage the negative, which thus loses its strength. Moreover, the section seldom has straight edges, as the cutting depends upon various factors, and particularly upon the hygroscopic state of the film, which in turn depends upon atmospheric conditions. During the cutting operation, the film will move more or less under the punch, and there will be formed a beveled part which is shown in the copy by a more or less transparent part, and this again causes a clacking noise. Finally, by reason of the small size, it is quite difficult in practice to make the perforation exactly in the proper place.

In addition to the particular defects above mentioned, all of the known processes have a common defect due to the fact that the covering consists in practice in a sound record consisting of an opaque or a transparent region having a constant opacity and a variable size, producing a predetermined variation of light upon the photo-electric cell.

Whether the covering is obtained by the use of a varnish or of a perforation, it is very difficult to give to the covered region a contour such that the sound which is reproduced shall be quite inaudible, for on the one hand, no form is really satisfactory nor has it an entirely universal character, and on the other hand there is no form available which is adapted both for the process of sound recording with variable density and for the process with constant density.

The forms which have been recommended are quite numerous, such as a double triangle, an arc of a circle, a diamond shape, parallelogram, sinusoid, etc. All such forms have the same drawback, as they replace the former clacking by different noises, whether in the process of sound reproduction with variable density or in any of the processes with constant density.

However, as the sinusoidal form is the only one which provides, theoretically, for the entire elimination of all parasitic noises, its defects will now be briefly mentioned.

In order that no sound should be heard, i. e., in order that the vibrations produced by the covering should not be audible, it is necessary

that its frequency should be above 20,000 or below 16.

As there is no question of using a frequency above 20,000, it is necessary to employ a frequency below 16, and the covered region should be limited by a perfect sinusoid corresponding to a frequency of 16 or below.

In practice, with the frequency of 16, the resulting silence may perhaps be somewhat long, as the reproducing apparatus will not generally allow the passage of frequencies below 40.

According to the degree of perfection of the reproducing apparatus, and to avoid an excessively long silence, it is necessary to utilize a frequency between 16 and 40.

On the other hand, as the amount of light which passes is controlled by the sinusoid, this latter must be accurately placed in position.

In the sound recording process with variable density, if this condition can be readily complied with—provided the punch is placed so that it will be exactly tangent to the edges of the track—the case is not the same for the processes with constant density, and to the general difficulties there must be added other difficulties which are almost insurmountable and which depend upon the recording system.

In fact, the idle positions of the spot of light upon the track will change from one sound recording operation to another, as the zero points of the recording apparatus are not absolutely identical, and hence there will be a transverse displacement of the record after each cementing operation. Again, even should they be exactly joined, it would be necessary to use a punch of such a flat shape (with a maximum ordinate of 0.1 millimeter) and especially in processes with double modulation, that it would be practically impossible to execute the perforation in a proper manner.

On the other hand, in this process it is required to make use of a different punch for each process of sound recording, which signifies a great practical difficulty for the printing laboratories.

The present invention has for its object a process for the covering of the sound tracks of films, bands, or like backing. The said process affords a remedy for all the aforesaid drawbacks inherent in the known processes which provide for a record with a constant density, and it is chiefly characterized by the fact that it consists in covering the defect or other anomaly in the sound track by an application having a variable opacity along the said track, which will cover the whole width of the track and will produce, during the audible reproduction, vibrations which are entirely inaudible.

This process is of a universal nature, and it is applicable to all classes of sound recording (of variable or of constant density) whatever be the effective width of the record. The covering thus produced will not cause any parasitic noises, it does not weaken the negative, it is quite economical and is easy to carry out, as it may be effected automatically and simply by a modification and an improvement of the copying apparatus, i. e., the apparatus for printing the positive films.

In a preferred embodiment, there is produced upon the positive alone an application of variable opacity of such nature that when the said positive travels in the sound reproducing apparatus, the light will vary according to an exactly sinusoidal function of the displacement of the said positive, and hence, as this latter moves

at a constant speed, according to an exactly sinusoidal function of the time.

Further characteristics of the said process will be set forth in the following description.

The invention has further for its object a film, band or like positive backing for a sound track, which is characterized by the fact that the defects or anomalies in the sound track are covered by the said process, that is, by the use of applications of variable opacity (and preferably according to a sinusoid) covering the whole width of the sound track and corresponding to inaudible sound vibrations.

The invention has for its object an apparatus for the utilization of the aforesaid covering process, said apparatus being chiefly characterized by the fact that it comprises, in combination:

Means providing for the production, upon the positive film or like backing of the sound track, of a luminous printing which affords, adjacent the sound track, and after developing, a region having a given length and a variable opacity (preferably according to a sinusoidal law);

And other means for starting the said printing at exactly the proper time, for instance by means of the negative or a duplicate of said negative, upon which the defects or anomalies to be covered have been preliminarily indicated.

In the accompanying drawings, which are given solely by way of example:

Fig. 1 is a front view of a portion of film which has been covered in accordance with the invention.

Fig. 2 is a curve showing the values of the different points of the covering, according to their distance from the starting point of the covering.

Fig. 3 is a partial front view on a larger scale.

Fig. 4 is a corresponding longitudinal section of the negative.

Fig. 5 is a front view of a portion of positive film, showing that the covering in accordance with the invention is applicable irrespectively of the lateral displacements in the sound track.

Fig. 6 is a longitudinal section of an apparatus for the application of the covering process in conformity to the invention.

Figs. 7, 8 and 9 represent partial sections on the lines 7—7, 8—8 and 9—9 of Fig. 6.

Fig. 10 is a partial plan view.

Fig. 11 is a detail view on a larger scale, of the drums of the apparatus shown in Fig. 6, and of a portion of the optical device.

Fig. 12 is a partial longitudinal section of a modification.

Fig. 13 is a cross section on the line 13—13 of Fig. 12.

Fig. 14 is a longitudinal section, on the line 14—14 of Fig. 16, of another apparatus, adapted for the use of the process in conformity to the invention.

Figs. 15 and 16 are cross sections on the lines 15—15 and 16—16 of Fig. 14.

Fig. 17 is a diagrammatic view of another mechanism which is adapted for the purpose and in which use is made of the piezo-electric properties of quartz.

Fig. 18 is a longitudinal section of another apparatus adapted for the use of the Kerr effect by electrostatic means.

Fig. 19 is a corresponding plan view, showing in particular a method for the production of the electrostatic field.

Fig. 20 is a curve showing, in ordinates, the intensity of the light issuing from the Kerr cell,

according to the value of the modulation current (in abscissae).

Figs. 21 and 22 are diagrammatic views of modifications in which the electrostatic field is replaced by an electromagnetic field.

Fig. 1 represents a portion of a positive sound film 1, improved in accordance with the invention. This film is of a normal type, and it contains the images 2, the rows of perforations 3 and 4 for its forward travel, and the sound track 5. The said track may be of the type with variable density or of the type with constant density, as shown by way of example on a larger scale in Fig. 3. In this figure, the part *ab* of the sound track corresponds to the audible sounds, and the part *bc* (in which the transparent part is reduced to a narrow marking line 6) to a silence.

The said positive film is obtained from a negative film, which is made up of sections such as 7 and 8 (Fig. 4) which are assembled by cementing, the gelatine surface 9 of the section 7, upon which the other section 8 is placed, being removed at *de*, on the covered part. The printing of the positive film from the negative film produces, adjacent the lines *d'd'* and *e'e'* of the negative (these lines, which correspond to the points *d* and *e* of Fig. 4 are supposed to be transferred to Figs. 1 and 3 representing the positive film) two white lines *mm* and *nn*. These lines constitute a defective part of the sound track, and should be eliminated on account of the clacking sound which they could produce during the audible reproduction.

In accordance with the invention, a remedy is provided for the defect consisting of the two lines *mm* and *nn*, or for any other defect or anomaly of the sound track by providing upon the whole width *l* of the said track, for a certain length *L* (Figs. 1 to 3) and extending on both sides of the defective place, an opaque region 10. The opacity *o* of the different points of this region will vary along the sound track according to a sinusoidal law, as represented in Fig. 2, which shows the variation of the opacity *o* with reference to the distance *y* from the considered point to the origin *pp* of this region; the opacity has a zero value at the two ends of the region, and is maximum exactly adjacent the defective point (consisting of the lines *mm* and *nn* in the present case).

When the sound track travels through the sound reproducer in the direction of the arrow *f*¹ (Fig. 3), and when the region 10 comes into the reproducer, for instance at *pp*, the said region will produce an acoustic vibration, but this vibration will be entirely inaudible, if the proper law for the variation of the opacity has been chosen. This will be the case if this opacity varies according to an exactly sinusoidal law, as the region 10 will then produce a vibration without harmonics (pure sound), and this may be readily selected outside of the audible frequencies, for instance below 16 vibrations per second, or outside of the frequencies which may be reproduced by the sound reproducers.

The clacking noises due to the cemented parts, or the noises due to any other defects to be eliminated, are now replaced by an inaudible region.

According to the preceding considerations, in order that an apparatus should permit of applying the said method in conformity with the invention, it should be so constructed as to comply with the following conditions:

(a) It should produce upon the positive film

a luminous line the length of which is equal to the width of the sound track, and which is situated upon the latter.

(b) When the apparatus is in operation, the illumination of this line should vary in such a manner that the photographic opacity resulting from the development, which is added to the opacity of the acoustic record to be covered over, shall be a perfectly sinusoidal function (without harmonics) of the abscissa at the considered point, starting from a given origin *pp*.

(c) The said origin *pp* should be situated at a distance from the defective place which is as near as possible to half the total length *L* of the covering.

(d) The opacity of the two ends of the covering should be as near as possible to a zero value.

Various apparatus are adapted to comply with these conditions, and these may be classified in several groups according to the nature of the physical phenomenon employed to produce the desired variation of the light.

The first class may comprise apparatus utilizing a source of light of constant intensity. The necessary variation of the light being obtained by sending the beam of light through a system adapted to graduate the light. Any system which will vary, according to the predetermined sinusoidal law, the total quantity of light of a beam, can obviously be utilized.

Figs. 6 to 11 represent an embodiment in which a beam of constant value traverses, at a point near the film, a screen the transparency of which varies according to a sinusoidal law. The beam is stationary, and the screen is moved in such manner that its linear speed corresponds to that of the film 1.

In accordance with the embodiment represented in Figs. 6 to 11, the positive film (Figs. 6—8—11) which is to be covered over, runs upon a toothed drum 11 which is driven at a periphery speed equal to the linear speed of the film, either by the mechanism of the copying machine (actuated drum) or by the film itself (loose drum), or by like means. A ratchet wheel 12 (Figs. 6—7) rotates together with the drum 11. The device 11—12 rotates loosely on a shaft 13. A disc 14 is keyed to the said shaft. The disc 14 carries the axle 15 of a pawl 16 which is urged into contact with the ratchet wheel 12 by a spring 16^a, thus rotating the shaft 13 along with the drum 11, i. e., in the direction of the arrow *f*². The said pawl is normally held out of action by a catch 17 (Figs. 6—7) forming part of the core of an electro-magnet 18. The circuit supplying the electro-magnet is normally opened by a switch 19. The closing of said switch is automatically effected at the proper time by the negative film 20 (Fig. 1) which travels in the apparatus in synchronism with the positive film 1, the drum 21 (Figs. 6 and 9) which drives the film 20 being, for instance, positively connected with the drum 11 by a set of gearing 22—23—24 (Fig. 6). It should be noted that the drums 11 and 21 might be mounted loose, and in this case they would be positively connected by gearing, or the like, with the feeding drums used for the positive film. To provide for the closing of the switch 19, the negative film 20 carries, in a determined position with reference to each cemented part or defect to be covered, a known releasing means such as a lateral notch 24 (Fig. 10), a perforation, a clasp, or the like, by which the switch 19 will be closed at the exact time. It should be observed that in order to prevent any weakening or deteriora-

tion of the negative 20, the said releasing means might be located on an auxiliary band which is actuated in synchronism with the films 1 and 20 at the same speed or at a proportional speed.

5 This ancillary band will be termed the duplicate band.

The drum 11 carrying the film 1 is hollow, and it has in its interior a second drum 25 which is also hollow. The drum 25 is secured to the shaft 13. In its opaque wall is an opening 26, across which an elastic split ring 27 maintains a screen 28 (Figs. 6—8—11) of variable transparency, consisting of a piece of film which has been blackened in such manner as to give a negative reproduction of the variation of the blackening which it is desired to obtain on the positive film 1, the length of the negative records on the film 28 and of the positive records on the film 1 having the same ratio as the diameters of the winding on the drums 25 and 11.

20 Between the drums 25 and 11 is mounted (Figs. 6—11) a stationary tube 29 having a rectangular opening 30 (Fig. 11) near its edge. The light used for the photographic action by which the covering is formed, proceeds from the interior of the drum 25, either a source of light being placed there, or a mirror or prism 31, reflecting the light from an external source of light 32, as represented (Fig. 6).

30 The operation is as follows: In normal action, the shaft 13 does not rotate, as the pawl 16 is separated from the ratchet wheel 12 by the core 17 which forms a stop. The drum 25 is stopped in a determined position such that the opening 30 in the tube 29 will be closed by the opaque part of the said drum 25.

When the negative 20 or the auxiliary band closes the switch 19, the electro-magnet 18 is excited at an exact time with reference to the travel, before the opening 30, of the part of the positive film containing the defect to be covered over. A suitable marking arranged once for all, and consisting for instance in a given spacing of the notches 24 (or like means) with reference 45 to the corresponding defects in the negative film 20, permits of placing the covering exactly at the desired point.

The pawl 16 is then released from the core 17, and makes contact with the ratchet wheel 12. 50 The shaft 13 is set in rotation, and the screen 28 passing before the opening 30, permits the photographic action.

When the shaft 13 has made a complete rotation, the pawl 16 will again engage the catch 55 and core 17, which has meanwhile been dropped by the electro-magnet, and it will thus separate from the teeth of the ratchet wheel 12, which latter will continue to rotate without driving the disc 14. The whole device is thus set in readiness 60 for the next covering operation.

65 An apparatus of the above-mentioned construction is attended with a drawback, due to the fact that it will only provide for the covering of cemented portions which are spaced apart by a distance which is at least equal to the circumference of the drum 11, i. e., of two cemented portions spaced by six or eight images.

In order to obviate this drawback, the diameter of the drum might be reduced to a sufficient degree, but in this case the positive film would have an excessive curvature. It would be preferable to place the electro-magnet axially with reference to the actuating drum 11 (Figs. 12—13), and to have it control a core 33 provided with a 75 disc 34 carrying a plurality of spindles 17 analo-

gous to the single core 17 used in the preceding case. This will afford, for instance, for a drum having 32 teeth, 8 stopping positions, and thus a possible stopping for every 4 perforations, i. e., for each image, thus affording two coverings which follow each other without interruption.

A modified form of the above-described apparatus may be so arranged that the screen of variable opacity and the film to be exposed will be stationary, whilst the beam of light is movable.

10 Figs. 14—15—16 represent a second modification, comprised in the second group of apparatus adapted for the use of the method of covering with variable intensity. This modification comprises a screen of suitable form which moves according to a given law, and the movement of said screen serves to diaphragm to a greater or less degree an objective which is so situated that the image of a source of light formed by the said lens will light a stationary slit. It is evident that the illumination of the slit should always be uniform, and that the slit, or its image on the film to be covered, should have a length equal to the width of the sound track and should be placed upon this latter.

25 In the embodiment represented in said Figs. 14—15—16, a shaft 35, connected with the mechanism of the printing apparatus, drives a transverse shaft 36 by gearing consisting of a worm-wheel 37 and a worm 38, and also a shaft 39 30 by spur gearing 40—41. To the shaft 36 are keyed the toothed drums 42—43, in which the number of teeth corresponds to n images of the film (for instance $n=8$, and the drums have 32 teeth). The speed ratios are such that for one revolution of the shaft 35, the shaft 36 will make

$$\frac{1}{n}$$

40 revolution (or $\frac{1}{8}$ in the present example), and the shaft 39 will make one revolution. Upon the drum 42 is wound the negative film 20 or the synchronous band carrying the releasing means adapted to act upon the contact device 19. Upon the drum 43 is wound the positive film. The said contact device controls, as in the preceding cases, the supplying circuit of an electro-magnet 18, which when excited, raises the core 17, thus allowing the pawl 16 to engage the ratchet wheel 12 which is keyed to the shaft 39. As the shaft 15 of the pawl is mounted on a disc 14, the said disc will now be rotated. The disc 14 is connected, as to rotation, to an eccentric 44 (Figs. 14—15) the frame 45 of which is supported by a slider 46, which is mounted in guides 47 and carries a shutter 48.

55 When the electro-magnet 18 is excited, this will produce an alternate movement of the slider 46, and this latter will impart its motion to the shutter 48. Said shutter is located in the diaphragm plane of an objective 49 adapted to form at 52, upon the film 1, the image of a slit 50 which is illuminated by a source of light 51. The shutter 48 is displaced in front of a rectangular diaphragm, in a direction parallel to one of the sides of the rectangle, and the amount of the displacement is equal to the length of the other side.

70 As the eccentric 44 is a circular eccentric provided with a frame, it is a known fact that the speed of translation of the shutter 48 will vary according to an exactly sinusoidal formula.

The illumination at 52, which is uniform at each instant, will thus vary after the manner of 75

the ordinates of a sinusoid when the eccentric makes one revolution.

Since the ratchet wheel 12, driven by the film or by the copying apparatus, rotates at a uniform rate and makes one revolution during the time in which one image passes in the apparatus (or 8 revolutions for one revolution of the drum 43 in the present case), the length of the covering which is thus produced is equal to the length of an image.

It is possible to cover cemented portions which are spaced apart by the length of one image.

Obviously, by changing the gear ratio, it is possible to give to the covering any desired length.

It is evident that the sinusoidal mechanical movement of the shutter 48, which serves to produce a sinusoidal variation of the beam of light falling upon the film 1, may be obtained by any mechanical or other means. Thus it is feasible to employ a sinusoidal variation of electric energy, for instance in the form of a sinusoidal variation of voltage.

For the transformation of this sinusoidal variation of voltage into a mechanical sinusoidal variation, use may be made of the piezo-electric phenomena.

It is well known, in fact, that a plate or rod of quartz which is suitably cut out of a crystal and is mounted in a known manner between the two plates of a condenser, has the characteristic of undergoing positive or negative elongations when the tension applied to the terminals of the condenser is varied.

It is thus feasible to employ a device (represented diagrammatically in Fig. 17) in which there is obtained a sinusoidal variation of one of the dimensions of a quartz plate 54, by applying to the terminals 55—56 of a condenser between which the quartz plate is located, a voltage which varies according to a sinusoid at the time of the passage of the cemented part of the negative film 20 or of its marking point situated at the chosen place.

These variations of the dimensions of the quartz may be utilized in any known manner, and for instance for the control of the shutter 48 adapted to close off, more or less, a beam of light from a source of light 51, in order to obtain the desired variation of the illumination.

The sinusoidal variation of the voltage is obtained automatically, for instance by the closing (by a switch 19) of the plate circuit of a quartz controlled tube oscillation generator 57, the oscillator of which is precisely the quartz plate 54, the variations of the elongation of which will produce the sinusoidal variation of the intensity of light.

Another embodiment of an apparatus of the first class may consist in the use of a system subject to mechanical vibrations (tuning fork, strings, etc.) having a suitable period depending upon the speed of the film, and to which is secured a small mirror. If the oscillations of the said system are free, it will vibrate according to a perfect sinusoid. A source of light is arranged in such manner as to send a beam of light upon the mirror, which reflects it upon the film. When the system is in vibration, the mirror will impart to the end of the beam upon the film an exactly sinusoidal motion, and as the amount of light falling upon the film depends upon the elongation, this amount will also vary according to a sinusoidal law.

In order that the movement of the film shall have but an insignificant effect, it will suffice

that the period of vibration of the system shall be sufficiently high ($\frac{1}{1000}$ for instance).

It is also feasible to utilize the phenomena of the polarization of light, for instance in the following manner. The beam of light passes through a first polarizing Nicol's prism, and then through a second, which is crossed with the first, in the idle position. In this case, no light will pass through. At the proper time, and by any suitable means which are put in action by the film, one of the prisms is turned, for instance the second prism (the analyzer), through 180° , and in a time which is equal to the time required by the film to move forward by a length equal to the length of the sinusoid which it is desired to obtain. If the rate of rotation of the prism is uniform, the amount of light falling upon the film during this rotation will vary according to a sinusoidal law.

It is further possible to utilize the Kerr effect, for instance as shown in Figs. 18 and 19. The light proceeding from the source of light 51, after passing through a first Nicol's prism, or polarizer 58, falls upon a second Nicol's prism, or analyzer, 59. Between the two is located a system consisting of a small condenser 60 immersed in a medium 61 having a high electric birefringent power (carbon disulphide, nitrobenzene, or a suitable crystalline medium), i. e., having a high Kerr coefficient. (The liquid may be contained in a closed bulb 62.) There is then applied to the plates of the condenser 60, in the first place a determined voltage v^1 (Fig. 20), termed voltage of polarization, which is just sufficient in order that the light issuing from the analyzing Nicol's prism 59 shall have a zero value. The value v^1 is so selected that the corresponding point i^1 of the curve $I=f(V)$ (Intensity I proceeding from the Kerr cell in proportion to the voltage applied to the terminals of the condenser 60) shall be located on the straight part $i^1 i^2$ of this curve. The adjustment is effected by means of the potentiometer 70 shown in Fig. 19.

This voltage is then varied at the proper time between the values v^1 and v^2 corresponding to the points i^1 and i^2 , and according to a suitable law in order that the light issuing from the entire system shall vary according to the required sinusoidal law.

The sinusoidal variation of the tension may be obtained by a lamp system of any known type.

The sinusoidal voltage is then properly modified and filtered, and the last stage of the amplifier acts upon the Kerr cell according to the arrangement of circuits, as shown in Fig. 19.

Use may also be made of magnetic birefringence in the following manner (Fig. 21). On the respective sides of the cell 62 are located two windings 63 and 64 which are connected in series and produce a magnetic field having the direction X—X perpendicular to the direction Y—Y of the beam of light. The value of the current flowing in these two windings 63—64 varies according to a sinusoidal law, by the use of any suitable means, for instance an eccentric 65 with frame 66 secured to a slider 67 movable upon a resistance 68. The said eccentric rotates with a uniform movement, and thus the slider will be given an alternating sinusoidal movement. The variable resistance thus formed is mounted in shunt upon the said windings.

As the said resistance varies according to a sinusoid, the current in the windings and hence the magnetic field will also vary according to a

sinusoid, and this will produce a sinusoidal variation of the light, by a proper choice of the constants.

The said device permits of acting upon one of the components of the light which is polarized by the Nicol's prism 53 and is of an elliptical nature.

It is also feasible to utilize the magnetic rotary polarization by mounting the windings 63—64 as shown in Fig. 22, so that the magnetic flux shall be parallel to the beam of light. In this case, the magnetic field will act in the known manner by rotating the plane of polarization.

A second class of apparatus may comprise the apparatus in which the variation of the light is obtained by means of a source of light the intensity of which varies according to the time, or to the length of the film which is displaced.

Use may be made, for instance, of the following devices:

A small incandescent lamp the filament of which has but little inertia for calorific effects, and in which the value of the current which it carries is varied according to a given law;

A luminescent lamp (such as a neon lamp) which provides a sufficiently actinic light and in which the difference of potential is varied according to a suitable law in order to obtain the desired variation of the light, for example, discharge lamps as used in television, lamps of the crater type, and chiefly the luminescent lamp such as is used for sound recording;

A system utilizing a cathode tube having a fluorescent screen at one end, in which tube there is effected a suitable variation of the potential of the plate which accelerates the electrons, etc. The sinusoidal variations of the intensity or the potential will be obtained in a known manner, either by means of a suitable alternator which is properly corrected, or more simply by means of a system adapted for electric oscillation according to an exactly sinusoidal law and actuating amplifiers which are suitably filtered.

In particular, an embodiment can be employed which consists of a tuning fork combined with a three-electrode valve which keeps up the vibration of the tuning fork. The said valve being followed by suitable amplifying valves which finally afford sinusoidal variations of intensity or potential of the desired value.

The tuning fork may be replaced by a self-oscillation valve which is mounted in a known manner and is followed by electric filters adapted to filter the desired frequency.

Obviously, the invention is not limited to the embodiments herein described and represented, which are given solely by way of example.

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

1. A device for eliminating in sound tracks of positive films obtained from the negatives of said sound tracks the defects or other anomalies of said negative sound tracks comprising an auxiliary band bearing marks spaced from each other in the longitudinal direction by distances which are proportional to the distances between the defects to be cured, a film guide provided with an exposure aperture, feeding means adapted to feed the positive film opposite said exposure aperture, a source of light, optical means adapted to pro-

ject a luminous beam from said source upon said positive film through said exposure aperture, controlling means adapted to vary the intensity of said luminous beam according to a sinusoidal law, feeding means adapted to feed said auxiliary band at a speed proportional to that of the positive, and operating means disposed on the path of the marks on said band and adapted to cooperate with said marks and to make said controlling means operative when said marks are brought into contact with said operating means.

2. A device according to claim 1, in which said controlling means consists of a filter having opacities varying according to a sinusoidal law, and driving means adapted to move said filter in the path of said luminous beam and to be made operative by said operating means.

3. A device according to claim 1, in which said controlling means consists of an opaque screen adapted to be displaced opposite said exposure aperture, and driving means adapted to move said screen opposite said aperture by lengths varying according to a sinusoidal law and to be made operative by said operating means.

4. A device according to claim 1, in which said controlling means consists of an opaque screen adapted to be displaced opposite said exposure aperture, a rotatable shaft, eccentric means connecting said shaft with said screen and adapted to move said screen by lengths varying according to a sinusoidal law when said shaft is rotated, and driving means adapted to rotate said shaft and to be made operative by said operating means.

5. A device according to claim 1, in which said controlling means consists of an opaque screen adapted to be displaced opposite said exposure aperture, an electric condenser, electric current generating means adapted to produce a sinusoidal tension on the plates of said condenser, a piezoelectric quartz between the plates of said condenser, connecting means between said quartz and said screen, and means adapted to be operated by said operating means and to make said generating means operative.

6. A device according to claim 1, in which said controlling means consists in polarizing means disposed in the path of said luminous beam, means adapted to convert the constant luminous intensity of the polarized beam into a luminous intensity varying according to a sinusoidal law, and means adapted to be operated by said operating means and to make said converting means operative.

7. A device according to claim 1, in which said source of light is an electric source of light, the luminous intensity of which varies proportionately with the tension applied to said source of light, and in which said controlling means consists of generating means adapted to apply to said source of light an electric tension varying according to a sinusoidal law, and means adapted to be operated by said operating means and to make said generating means operative.

8. A device according to claim 1, in which said controlling means comprises a mirror adapted to deviate said luminous beam on and away from the sound track of the positive, and means operated by said operating means and adapted to cause said mirror to oscillate freely according to a sinusoidal law.

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