

Jan. 1, 1935.

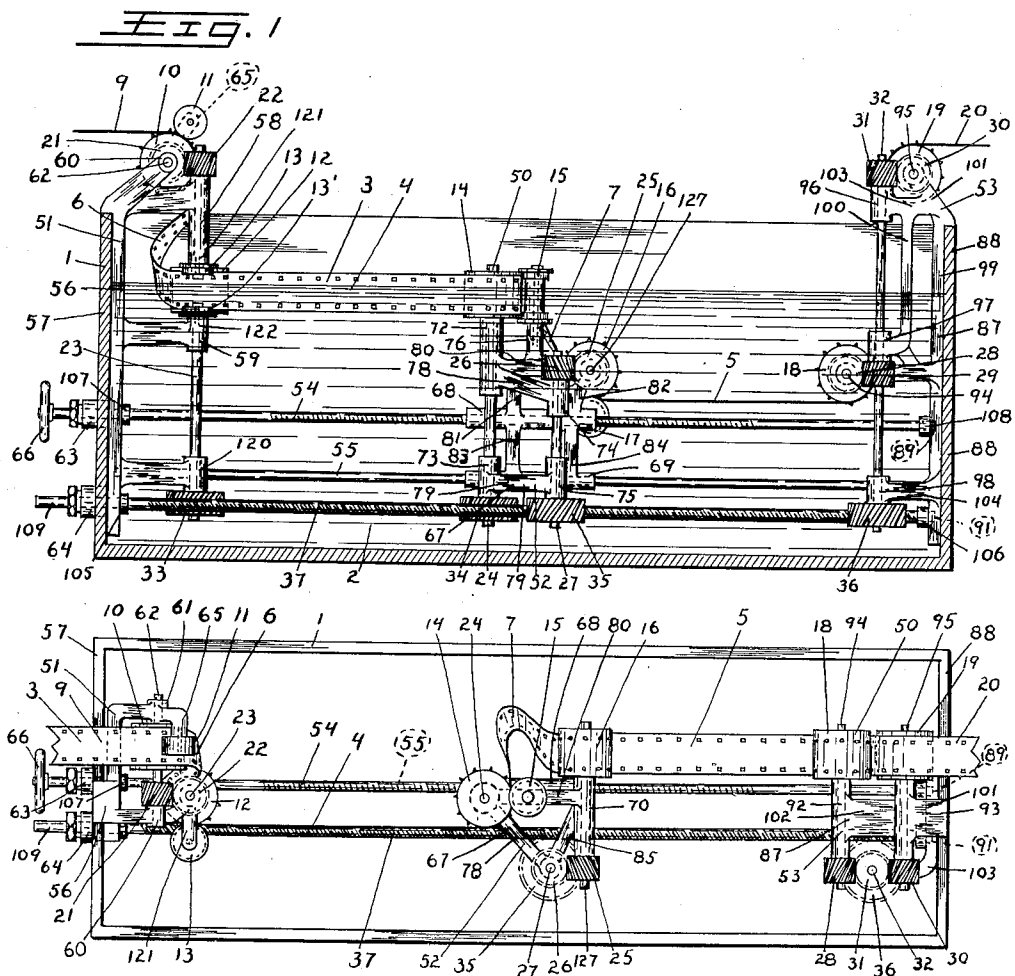
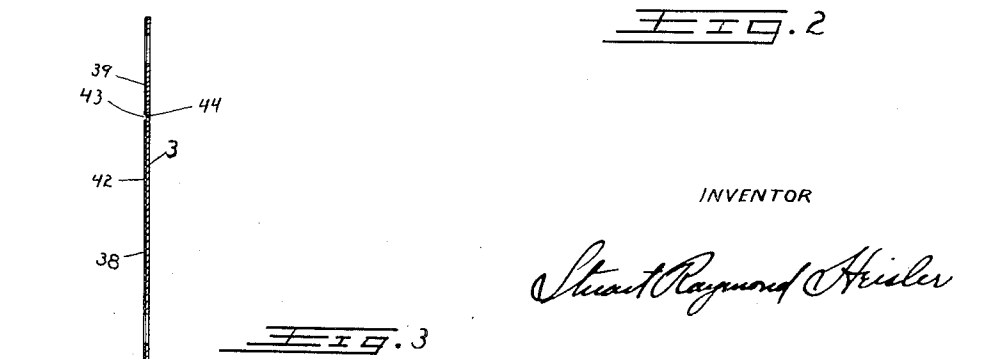
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1,986,107

APPARATUS FOR DEVELOPING SOUND TRACK MOTION PICTURE FILM

Filed July 29, 1930

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

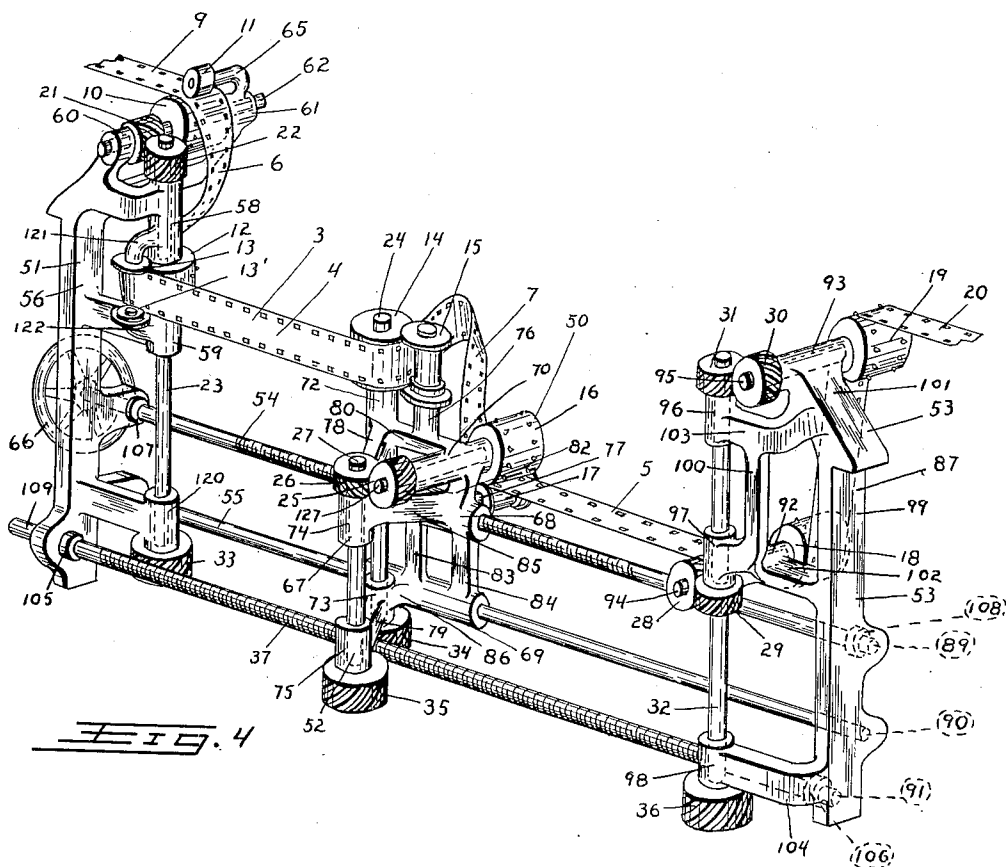


FIG. 4

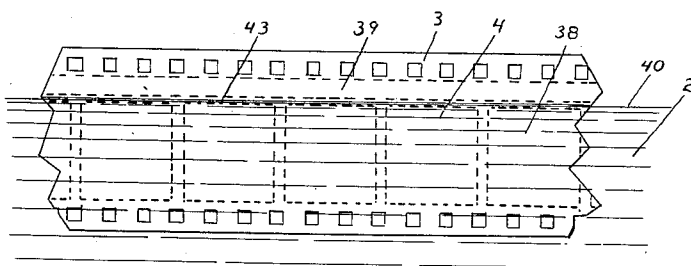


FIG. 5

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APPARATUS FOR DEVELOPING SOUND
TRACK MOTION PICTURE FILMStuart Raymond Heisler, Los Angeles, Calif., as-
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9 Claims. (Cl. 95—94)

This invention relates to an apparatus for developing sound track motion picture film and the main object thereof is to produce a positive film ready for exhibition purposes having two parallel tracks of photographic impressions, one track being of motion pictures and the other being a series of impressions from which the sound accompaniment may be reproduced by suitable apparatus, each of said tracks being developed to a different gamma.

In the production methods now generally used independent control can be exercised over each step of the process of producing the photographic impressions of the sound and picture tracks up to that point in the process where the development of the release print takes place. The general practice is to print each track of impressions onto the positive film from separate negatives while the opposite track is masked off and then to run the film carrying the latent images of both tracks thru the developing machine in which both tracks receive identical treatment after which the film is dried and reeled.

Apparatus for exhibiting the production permits independent control over the output from the two tracks of developed impressions. Thus in the entire series of operations in the process of filming a show and exhibiting the same the only step in which the operation on the two tracks of impressions is interdependent in the present general practice is the step of developing the release print.

Because of this single fact, that the two tracks must under the present film laboratory practice receive identical treatment in the development of the release print, serious limitations are imposed on all of the operations leading up thereto and compromises must be made to permit compliance with this requirement. The cost of production is increased over what it would be were independent control exercised over the processing of the two tracks through the entire production and the quality of the effects secured is impaired as it is necessary to sacrifice part of the possible results that could otherwise be secured.

In the development of photographic record on film the controlling factors are expressed by a sensitometer curve in which the log. exposure is plotted against the density of the developed film given any one value of the length of time in the developer. The exposure is the product of the intensity of the light and the time it has been applied. For each value of the length of time in the developer a different curve may be

drawn. The tangent of the angle made by the straight portion of the curve and the abscissa of the coordinate system is known as the gamma to which the film has been developed. In a film developed to a gamma of one the contrast of the film is considered to be equivalent to brightness contrast of the scene. A value of gamma greater or less than one indicates that the contrast of the film is greater or less than the contrast of the scene. The product of the negative gamma and the positive gamma is termed the over-all gamma. For the best production of brightness relationships the over-all gamma should be equal to unity. As a practical matter in the production of motion pictures a value of slightly greater than unity is used to allow for losses of detail in the projection apparatus.

In the production of the picture track a different set of conditions prevail than in the production of the sound track and from an artistic viewpoint different result are looked for by different photographers. Because of artistic considerations the picture negative is usually developed to a gamma much less than one and the positive to a gamma greater than one. An average set of values is considered to be a gamma of 0.55 for the negative and 2.00 for the positive giving an over-all gamma of 1.10. However these values are discretionary and it is desired that the producer may be able to vary them at will.

A positive film developed to a gamma of 2.00 has a greater average of density values than a film developed to a gamma of one, hence in the reproduction of sound from such a film it is necessary to make use of a very intense source of light to get the equivalent reproduction currents in the sound apparatus to that which could be secured by the use of film having a sound record suitably exposed and developed to a gamma of one. Not only does this mean a loss of power but it introduces mechanical complications as there is a practical limit to the amount of light that may be developed and transmitted thru the very small apertures of sound apparatus.

The most serious drawback in the prior art practice however, is that in order to provide a picture track of the quality which the public has learned to expect harmonic distortion is produced in the sound record due to the limitations imposed upon the filming thereof by the fact that in the release print both tracks must be developed to the same gamma. The explanation of this is as follows:

The projection of the straight portion of the characteristic sensitometer curve of any particu-

lar film stock upon the abscissa of the coordinate system is termed the latitude and indicates the range of values over which the exposure may be varied and be faithfully represented by the resulting developed images. I find that the latitude decreases with the increase in gamma and that the distortion which is now common in such records is due to the fact that the exposure values can not be held within the latitude when a gamma of much greater than one is selected. Therefore this invention provides for the use of that value of gamma for both negative and positive films which allows the greatest range of values of the exposure in both the negative and positive films.

Thus we see that for the securing of the best results from both the sound track and the picture track they must be developed to different gamma values. In the case of the picture track a considerable difference is indicated as necessary between the gamma of the negative and of the positive films and in the case of the sound track I have discovered that the most suitable set of values with present film stocks is a gamma of one for both negative and positive. While it is necessary in the case of the picture track to have an over-all gamma of something over unity to allow for dispersion in the lens system, on the screen and from various other factors in projection, this condition need not be observed in the selection of the over-all gamma of the sound track. In fact it appears that a value of unity is clearly indicated as most efficient and satisfactory for the sound track.

In general the object of the invention is to provide a simple and efficient means for developing a film of the type described in two stages. In the first stage the film is immersed in the developing bath only sufficient to wet and develop the images of one of the two tracks. In the second stage the film is completely submerged in the bath and the development of both tracks takes place together, the track that was first immersed thus being developed for a longer period of time is developed to the higher gamma. Usually this would be the picture track. As for different work it is desired to have a different ratio between the times consumed while a point on the film is passing thru the machine in each of the two stages, a further object of the invention is to provide a simple and rapid means of varying the ratio of the lengths of film threaded thru the two sections of the machine in which the two stages of development take place. Since in practice various different pieces of film are run thru the machines in commercial film laboratories from different productions which in using this invention will be specified for development for times having different ratios, it is a further object to provide means for changing this ratio while the film is in motion without interrupting the flow of work thru the machine and without taking up or letting out slack film at any point.

A further object is to provide means for preventing the solution from climbing up onto that portion of the film which is out of the bath in the first stage of the development.

Further objects will become apparent from the following description.

An embodiment of the invention is illustrated in the accompanying drawings, but it is to be understood that this invention is not limited to the particular type of apparatus shown, as without departing from the spirit of the invention

it may be embodied in numerous ways within the purview of the claims.

Figure 1 is a longitudinal sectional view thru a tank in which is contained the mechanism for traversing the film thru the bath, the bath being shown submerging the mechanism up to the division line of the two tracks of the film in the first stage of the developing process.

Figure 2 is a plan view of the machine shown in Figure 1.

Figure 3 is a cross section thru a film enlarged to show how a film may be prepared to reduce the tendency of the developing solution climbing onto the upper track of the film in the first stage of the development.

Figure 4 is a perspective view of the mechanism with a length of film threaded thru it to illustrate more clearly the general relation of the various elements.

Figure 5 is a view of a section of film shown partly submerged in the bath in the first developing position in the machine showing the position of the surface of the bath in relation to the two tracks of photographic impressions.

In the drawings, numeral 1 indicates the tank in which is the developing bath 2 and a machine 50 for traversing the film 3 thru the bath. The various elements are not shown in true proportion, being exaggerated where necessary in order to more clearly illustrate the general arrangement and the relation of the various elements to each other. It is particularly to be noted that the two lengths of film 4 and 5 in practice are much greater than indicated in the views and that the proportion of the lengths of film in the loops 6 and 7 is so small as to be negligible.

The film enters the machine at 9 runs between the sprocket 10 and the idler 11, passes thru the loop 6 to the sprocket 12 and idlers 13 and 13' and then in a vertical plane it travels over the stretch indicated by 4 partly submerged in the bath. At the end of the stretch 4 the film passes between the sprocket 14 and idler 15 and thence thru the loop 7 becoming completely submerged in the bath and after passing between the sprocket 16 and the idler 17 travels over the stretch 5 to the sprocket 18, then rises out of the bath to the sprocket 19 and leaves the machine as indicated at 20 to the next units in the plant to be washed, fixed, dried and reeled.

The sprockets are all driven at the same speed so that the film is maintained taut in the same relative positions as it passes thru the machine. The sprocket 10 is driven thru the right hand helical gear set 21—22 by the shaft 23 on which is mounted the sprocket 12. The sprocket 14 is driven by the shaft 24. The sprocket 16 is driven thru the left hand gear set 25—26 by the shaft 27. The sprockets 18 and 19 are driven thru the right hand spiral gear sets 28—29 and 30—31 by the shaft 32. The shafts 23, 24, 27 and 32 are driven respectively by the worm gears 33, 34, 35 and 36 having a pitch diameter equal to the diameter of the sprockets plus the thickness of the film. All of the worm gears are of the same pitch diameter. All of the sprockets are of the same diameter. All of the helical gear sets have a one-to-one ratio.

The worm gears are driven by the worm shaft 37. Thus as the peripheral speed of all of the sprockets is the same, the lengths of film between the sprockets remain constant as the film passes thru the machine.

The mechanism is made in three sections, the assemblies 51, 52 and 53. The assemblies are

connected together in operation by the worm shaft 37, the screw shaft 54 and the smooth shaft 55. The assembly 51 starts the film thru the bath in a partially submerged position. The assembly 52 turns the film over, completely submerging the same. The assembly 53 directs the film out of the bath.

The assembly 51 includes the frame 56 which is secured to the wall 57 of the tank 1, the bearings 58, 59 and 120 thru which extends the shaft 23, the bearings 60 and 61 thru which extends the shaft 62 on which is mounted the gear 21 and the sprocket 10, and the arms 65, 121 and 122 which carry the idlers 11, 13 and 13'. The stuffing boxes 63 and 64 formed with the frame 56 provide means for the shaft 54 and the worm shaft 37 to extend outside of the tank.

The assembly 52 is adjustable lengthwise in the tank and may be moved backwards and forwards without giving or taking slack in any part of the film either while the machine is still or while the film is in motion. This is accomplished by turning the hand wheel 66 thus moving the frame 67 by virtue of the internal threads in the sleeve 68. The smooth bored sleeve 69 slides along the shaft 55 which maintains the assembly in its correct position with respect to the worm shaft and the film. It is to be noted that the worm gears 34 and 35 being on opposite sides of the worm shaft equalize each other in thrust and thus the worm shaft needs no support from bearings other than at the ends of the tank. The frame 67 includes the bearing 70 thru which passes the shaft 127 on which are mounted the gear 25 and the sprocket 16, the bearings 72 and 73 thru which passes the shaft 24, the bearings 74 and 75 thru which pass the shaft 27, the arms 76 and 77 which carry the idlers 15 and 17, and the frame members 78, 79, 80, 81, 82, 83, 84, 85 and 86 which connect the various bearings together.

The assembly 53 includes the frame 87 which is secured to the end 88 of the tank 1. The ends of the shafts 54, 55 and 37 fit into suitable bearings as indicated at 89, 90 and 91. The screw shaft 54 is positioned by the collars 107 and 108. The worm shaft 37 is positioned by the collars 105 at the two ends of the machine and 106 at opposite ends and is driven by any suitable means from the end 109. The frame includes the bearings 92 and 93 thru which pass the shafts 94 and 95 respectively, which carry the gear and sprocket sets 28-18 and 30-19 respectively; the bearings 96, 97 and 98 thru which the shaft 32 extends; and the frame members 99, 100, 101, 102, 103 and 104 which connect the various bearings together.

In threading the film thru the machine the emulsion side is turned away from the sprockets. As the film passes over the stretch indicated by 4 it is desired that only one of the tracks of latent images be in contact with the developer. The results of the process are not extremely critical as to this requirement for if a small amount of development does take place on the upper track the quality is only slightly lowered. However for the best results care must be exercised in constructing the apparatus to avoid climbing of solution onto the emulsion side of the upper part of the film at the sprocket 12. To this end the two idlers 13 and 13' have been here shown instead of a single idler. However at 15 it is immaterial if solution climbs up the idler and wets the top of the film inasmuch as the film is com-

pletely submerged immediately after passing by the idler.

In Figure 5 I have shown the relation of the surface of the bath to the two tracks of latent images in the first stage of development. Numeral 38 indicates the track of picture records and 39 the track of sound records and 40 the surface of the bath.

I have found that climbing of solution during the time that the film is passing over the stretch 4 by capillary action can be prevented by providing the film with a discontinuity of the emulsion surface. This may best be done by making a scratch thru the emulsion down to the celluloid. In Figure 3 a cross section of a film is shown so devised. The emulsion side of the film is indicated by 42 and the scratch by 43. If the scratch is deep enough to expose the celluloid as at 44 the probability of solution climbing is very small as the celluloid is not wetted by the solution. As a practical matter the apparatus should be adjusted so that the scratch is just above the surface of the bath rather than to attempt to make the two coincide.

Thus while I have described my invention in detail and with respect to a preferred embodiment thereof, I do not desire to be limited to the specific apparatus shown or the particular arrangement of parts insofar as permissible modifications under the broad ideas disclosed are concerned, since many changes and modifications thereof are possible and the invention may be embodied in widely varying forms without departing from the spirit and scope thereof in its broader aspects. Hence I desire to include all modifications and arrangements coming within the language and scope of any one or more of the appended claims.

Having thus described my invention, what I claim is:

1. In an apparatus for developing sound track motion picture film containing two parallel tracks of latent photographic impressions each of which is to be developed to a different gamma, a tank adapted to contain a developing bath and means to traverse said film thru said bath in one operation in two stages, each length of said film being maintained substantially in a vertical plane and immersed only sufficient to wet that one of the two tracks of latent images which is to be finally developed to the higher gamma in the first of said stages, there being means to alter the position of said film with respect to the surface of said bath at the end of the first stage and to completely immerse said film whereby both said tracks of latent images are developed together in the second of said stages.

2. In an apparatus for developing sound track motion picture film, a tank adapted to contain a developing bath, mechanism fixed with relation to said tank and located at one point of the surface of said bath to direct a film into said bath and start the same traveling thru said bath partly submerged in the same, mechanism fixed with relation to said tank and located at another point of the surface of said bath to receive said film after it has traveled a distance thru said bath partly submerged and to alter the position thereof with respect to the surface of said bath so that it becomes completely submerged in said bath and to start the same traveling farther thru said bath completely submerged, and mechanism fixed with relation to said tank and located at a third point of the surface of said bath to receive said film after it has traveled

a distance thru said bath completely submerged and to direct the same out of said bath.

3. In an apparatus for developing sound track motion picture film, a tank adapted to contain
5 a developing bath, mechanism fixed with relation to said tank and located at one point of the surface of said bath to direct a film into said bath and to start the same traveling thru said bath partly submerged in the same, mechanism fixed
10 with relation to said tank and located at another point of the surface of said bath to receive said film from a position of complete submergence and to direct the same out of said bath, and mechanism fixed with relation to said tank so
15 as to be adjustable along the line of travel of said film thru said bath to alter the position of said film with respect to the surface of said bath from a position of partial submergence to a position of complete submergence.

4. In a film developing machine, in combination, a tank adapted to contain a developing bath, mechanism fixed with relation to said tank and including a sprocket positioned in proximity to the surface of said bath and disposed to traverse a film thru said bath partly submerged therein, a second sprocket similarly disposed with respect to the surface of said bath and spaced from the first said sprocket, and a third sprocket disposed in proximity to the first said sprocket
30 and so positioned with respect to the same that a film looped between both said sprockets may travel from a point outside of said bath over the third said sprocket, thru said loop and around the first said sprocket and then thru said bath partly submerged therein to the second said
35 sprocket, means to maintain said film in contact with said sprockets in the manner described and means to drive all of said sprockets together at the same peripheral speed.

5. In a film developing machine, in combination, a tank adapted to contain a developing bath, mechanism fixed with relation to said tank including a sprocket positioned in proximity to the surface of said bath and disposed to traverse a film thru said bath partly submerged therein, there being means to traverse said film from a point outside of said tank to said sprocket and means to maintain said film in engagement with said sprocket, another sprocket similarly positioned with respect to the surface of said bath and disposed to receive said film after said film has traveled thru said bath partly submerged therein, said second sprocket being adjustable along the line of travel of said film thru said
55 bath, and means to drive both said sprockets at the same peripheral speed, said driving means being geared to add or to subtract an amount of peripheral movement to the movement of the second said sprocket exactly equal to the lineal
60 movement away from or towards said first sprocket in adjustment along the line of travel of said film.

6. In a film developing machine, a tank adapted to contain a developing bath, mechanism fixed
65 with relation to said tank and including a vertical shaft, a sprocket on said shaft disposed to move a film thru said bath in a vertical plane and partly submerged therein, said shaft continuing upwards and driving a second shaft in
70 a horizontal plane thru suitable gears, there be-

ing another sprocket on said horizontal shaft, the diameters of said sprockets and the ratio of said gears being such that both said sprockets turn, when driven, at the same peripheral speed, and suitable means to maintain a film in contact
5 with said sprockets and looped over the top of said second sprocket and partially around the first said sprocket in engagement with the teeth thereof, whereby upon a film being threaded in said manner thru said device and the same being driven in the proper direction, said film will
10 pass over the upper of said sprockets, thru said loop, and around the lower of said sprockets, and thence thru said bath in a partly submerged position running continuously as long as driven
15 without taking or giving slack in said loop.

7. In a film developing machine, a tank adapted to contain a developing bath, means to start a film traversing thru said bath in a vertical plane and partly submerged therein and a carriage adjustable along the line of travel of said
20 film thru said bath and having a vertical sprocket to receive said film as it approaches said carriage in a vertical plane and partly submerged and another sprocket located with the axis thereof in a horizontal plane and the lower part thereof being below the surface of said bath, both
25 said sprockets being driven together and at the same peripheral speed so that a film looped around the first said sprocket and under the second said sprocket will pass thru said carriage without taking or giving slack in said loop when driven, there being means to keep said film in
30 engagement with the teeth of said sprockets, and means to adjust said carriage along the line of travel of said film and at the same time to add or to subtract to the peripheral speed of said sprockets just sufficient to take up or give out a length of film equal to the linear change in
35 position of said carriage along the line of travel of said film.

8. In a machine for developing sound track motion picture film, a tank adapted to contain a bath of developing solution, means for traversing a film thru said bath in a vertical plane and partly submerged for a portion of the length
45 of the travel of said film thru said bath and means for twisting said film over into a horizontal plane and traversing the same thru a loop whereby the film becomes completely submerged for the remainder of the distance of its travel thru said bath.

9. In an apparatus for developing sound track motion picture film containing two parallel tracks of latent photographic impressions one of which
55 is to be developed to a different gamma than the other, a tank adapted to contain a developing bath, means to guide said film in continuous traverse from outside the tank into the bath and thru said bath in a partially submerged condition for the first part of its travel thru said bath to start the development of one of said tracks of images, and means to alter the position of
60 said film with respect to the surface of said bath at the end of said first portion of travel so that said film is completely submerged in said bath for the remainder of its travel thru said bath, and means to guide said film out of said bath at the end of its travel therethru.

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