

Sept. 6, 1927.

1,641,220

D. F. COMSTOCK

CINEMATOGRAPHY

Filed Jan. 8, 1923

Fig. 1

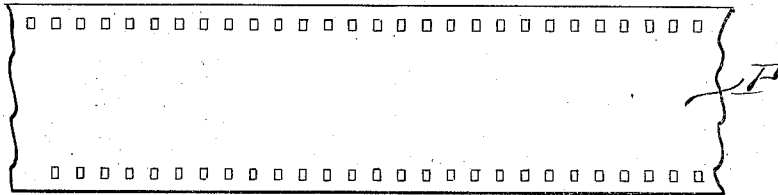


Fig. 2

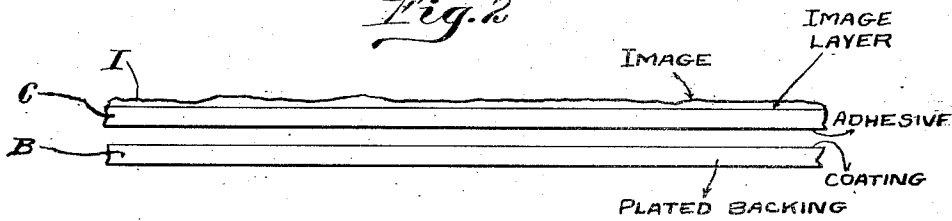


Fig. 3

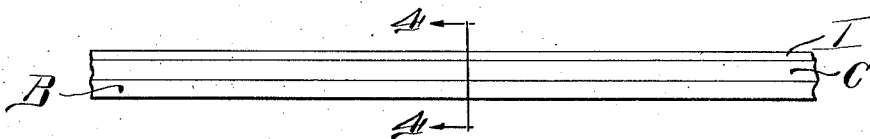


Fig. 4

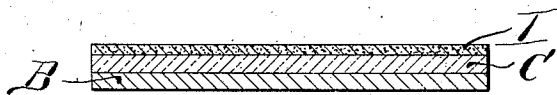
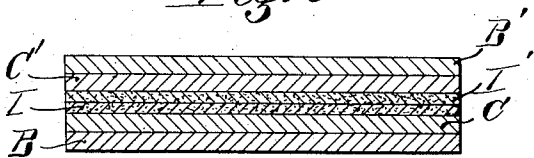


Fig. 5



Inventor:

Daniel F. Comstock

*by Roberto Roberto & Cushman
attys*

UNITED STATES PATENT OFFICE.

DANIEL F. COMSTOCK, OF BOSTON, MASSACHUSETTS, ASSIGNOR TO TECHNICOLOR
MOTION PICTURE CORPORATION, OF BOSTON, MASSACHUSETTS, A CORPORATION
OF MAINE.

CINEMATOGRAPHY.

Application filed January 8, 1923. Serial No. 611,257.

An inherent fault of cinematographic films is their tendency to shrink and expand under varying conditions of moisture. For example, an ordinary cinematographic film shrinks from one-tenth to one-fourth per cent in the wetting and drying processes incident to the developing process, this shrinkage varying approximately ten per cent of itself for similar pieces of film treated in the same general way; fresh film shrinks about one-twentieth per cent per day for many days if unsealed; and film expands approximately one-hundredth per cent for each added degree of humidity in the surrounding atmosphere.

While this shrinkage and expansion is more or less troublesome in the black-and-white branch of the art, it involves difficulties of the first order in the color branch of the art where the complemental pictures representing the different color aspects must be registered with a high degree of accuracy, the registration being effected in the projection stage of certain processes, such as most additive processes, and in the exposing or printing stage in other processes, such as most subtractive processes.

For example in producing color cinematographic films by imbibition of dye between the printed film and one or more matrix films, where a plurality of series of images (e. g. one series representing the red aspect and another series representing the green aspect of the scene) are printed in superposition on a single film, either on the same side or on opposite sides of the film, the complemental images must be registered with respect to each other with extreme accuracy, viz., within approximately one-thousandth of an inch of exact registry; and operating against this accurate registration are many troublesome factors chief of which is the tendency of the matrix films to shrink in the interim between the formation of the images thereon and the reproduction of the images on the printed film, this shrinkage not only changing the size of the images but also altering the relationship between the images and their corresponding sprocket holes or other registering openings. Moreover, since imbibition processes ordinarily require relatively long lengths of film to be simultane-

ously in register, difference in longitudinal length produces a cumulative effect with respect to faulty registry. With the respective series of images (red and green for example) upon separate matrix films the difficulty is rendered still more complex by unequal shrinkage of the respective matrices.

While air shrinkage is considerable the aforesaid shrinkage is caused principally by the wet process through which the films pass in the production of the images thereon. For example, in preparing imbibition matrices by a photographic process the images are first printed on the film and subsequently developed and otherwise subjected to liquid treatment which gives rise to the shrinkage.

The objects of the present invention are to overcome the shrinkage difficulties in cinematographic films and to make it possible to reproduce the images with accuracy and uniformity; and more particularly to provide a master or matrix film whose dimensions are substantially unaffected by moisture, which is less subject to tearing or other mechanical injury than the ordinary film, and which is much more durable in use.

In one aspect the invention comprises a cinematographic strip or film having cemented or otherwise attached thereto a backing, such as a steel or other metallic ribbon, whose dimensions are substantially unaffected by moisture and which has sufficient strength to prevent substantial shrinkage or expansion of the film. The aforesaid backing is provided with a series of openings for positioning succeeding sections of the film (the film also having corresponding openings if the film extends the full width of the backing) and the images or pictures on the film bear uniform relation to the openings by which they are positioned respectively. A backing in the form of a thin steel ribbon offers satisfactory strength and flexibility; and a copper surface (either a copper alloy or relatively pure copper) adheres especially well to the film. Consequently, the backing is preferably in the form of a thin steel ribbon copper plated. The backing is also preferably lacquered and dried before the film is cemented thereto as will appear hereinafter.

In another aspect the invention consists in

the method of producing cinematographic films which comprises mounting a light-sensitive strip on a band or backing such as above referred to, forming a series of pictures on the strip by a process involving a wet treatment, as by exposure and development, the latter being effected while the film is mounted on the band or backing so that the film is restrained from shrinkage during and following the wet treatment.

In making matrices of the relief type it is desirable to print or otherwise expose the film through the back so that the exposed portions of the emulsion are next to the celluloid or other support and the unexposed portions are on the outside, whereby the unexposed portions may be etched off without detaching the exposed portions from the support. Consequently, when the aforesaid backing is opaque, as in the case of a steel ribbon, the photographic strip is exposed through the back before being cemented or otherwise mounted on the backing and is then mounted on the backing before being developed or otherwise subjected to conditions which would alter its dimensions. With the strip thus supported and held against shrinkage or expansion the images or pictures formed thereon are held in uniform and fixed position relatively to each other and to the sprocket holes or other positioning openings by which they are respectively registered, whereby they may be reproduced in accurate registry by means of the sprocket holes or other openings notwithstanding the inherent tendency of the photographic layer of the film or band to expand and shrink as a result of wetting and drying or changes in the conditions of moisture to which it is subjected.

In a more specific aspect the invention consists in reproducing cinematographic films by forming an imbibition matrix on a flexible band such as above referred to, and forming pictures on another film by transfer of dye between the matrix and the other film, the band serving to prevent substantial shrinkage or expansion of the matrix as a result of wetting the matrix with the dye, which wetting is repeated for each film printed from the matrix.

As an illustration one embodiment of the invention is shown in the accompanying drawing, in which,—

Fig. 1 is a face view of the cinematographic film;

Fig. 2 is an edge view of the film and a backing before being attached together;

Fig. 3 is a similar view of the parts after being joined;

Fig. 4 is a section on line 4—4 of Fig. 3; and

Fig. 5 is a section similar to Fig. 4 showing one method of printing.

In the drawings P indicates a photographic strip comprising a light-sensitive or image layer I and a supporting layer C which may be celluloid, and B indicates a backing such as above referred to.

A backing of brass can be readily cemented to a celluloid film but such a backing is easily dented. A backing of steel ribbon has the necessary strength and flexibility and is not easily dented. About four-thousandths of an inch is a satisfactory thickness for the backing. With certain cements, such as the cement hereinafter described, the adhesion between the film and a steel backing is improved by copper plating the backing, either with copper or an alloy of copper. The plating may be carried on continuously as, for example, by continuously feeding the steel ribbon through the following stages in succession; acid bath, water bath, caustic scrubber, water bath, electrolytic bath, washer, acid bath, washer and drier. The adhesion is also improved by coating the backing with a lacquer, such as Dupont's pyralin lacquer, the lacquer being dried preferably at a temperature of about 120° to 125° F.

A suitable cement for use with a film whose base is celluloid comprises amyl acetate with an admixture of a small amount of camphor, the acetate serving as a celluloid solvent to soften the surface of the celluloid and render it adhesive. When the film and backing are brought together in the cementing process they are preferably pressed together as by feeding them between pressure rollers. After the film and backing have been cemented together the resulting product is preferably subjected to a temperature of the order of 125° F. for about thirty minutes. For some purposes the lacquering and cementing may be effected in a single stage by mixing the lacquer and cement (e. g. pyralin lacquer and amyl acetate), using the mixture as a cement between the film and an unlacquered backing, and subsequently drying the combined film and backing at approximately 125° F.

For certain uses, for example where the film need not be exposed until after it has been joined to the backing, the combined film and backing may be perforated as a unit; in this case the photographic film may if desired be confined to the space between the perforations in the backing.

When the film and backing are joined after being perforated the joiner may be effected by apparatus such as disclosed in the application of Troland and Ball, Serial No. 500,842, filed September 15, 1921.

In making matrices of the relief type, the film is preferably printed through the back with the images in uniform relation to the perforations by which they

are to be subsequently registered, the film is then joined to the backing and subsequently developed and etched. The film is then developed and hardened throughout the exposed portions of the emulsion so that the unexposed portions may be etched off with hot water. In a two color process one matrix reproduces the red aspect of the scene and another matrix the green aspect. In producing a subtractive color film from the two matrices the red and green images may be successively printed by imbibition on the same blank film, the complemental images being printed in accurate registration by virtue of the backings holding the matrix images in the same relationship to the perforations by which they are registered with corresponding perforations in the blank film.

Instead of using the films on the backings as master or matrix films they may be suitably colored (e. g. red and green, respectively) and then cemented together face to face, after which the backings may be stripped off leaving a subtractive two-color film both of whose outer faces are celluloid. The coloring dyes may be restrained from migrating from one film to the other by mordanting. Where the backings are to be stripped off a less tenacious cement should be used, for example shellac.

The film to be printed may likewise be mounted on a metallic ribbon or other flexible band whose dimensions are substantially unaffected by moisture and which has sufficient strength to prevent substantial shrinkage or expansion of the film. This is particularly advantageous in producing a color film where a plurality of series of images representing different color aspects of the scene are successively printed from different films since the metallic backing holds the film against shrinkage or expansion in the interim between successive printings and also affords more accurate registration by virtue of its rigid engagement with the registering pins. This method of printing is illustrated in Fig. 5 where I, C and B represent the image-layer, celluloid and backing, respectively, of the printing film and I', C' and B' respectively represent the image-layer, celluloid and backing of the film to be printed. After the latter film has been completely printed it may be stripped off the backing B' for projection. To facilitate stripping the aforesaid copper plating may be omitted and a less tenacious cement, such as a cement which does not soften the celluloid, may be used.

I claim:

1. An article of the character described comprising a cinematographic film and a thin ribbon having a copper surface adhering to one side of said film.

2. An article of the character described comprising a cinematographic film and a

thin steel ribbon having a copper plated surface adhering to one side of said film.

3. The method of producing cinematographic films which comprises forming latent images on a photographic strip by exposure through the back, mounting the strip on a flexible backing whose dimensions are substantially unaffected by moisture and which has sufficient strength to counteract shrinkage or expansion tendencies of the strip, and subsequently developing the latent images.

4. The method of producing cinematographic films which comprises forming latent images on a photographic strip by exposure through the back, cementing the strip to a flexible metallic backing, and subsequently developing the latent images.

5. The method of producing cinematographic films which comprises forming registering openings in a photographic strip at recurrent intervals, forming latent images on said strip in uniform relationship to said openings, mounting the strip on a flexible backing whose dimensions are substantially unaffected by moisture and which has sufficient strength to counteract shrinkage or expansion tendencies of the strip, with said openings in uniform positional relation to corresponding openings in the backing, and subsequently developing the latent images.

6. The method which comprises forming on a cinematographic film a series of images representing successive time phases of an object-field, and with the images accurately in standard spaced relationship mounting the film on a flexible band whose dimensions are substantially unaffected by moisture and which has sufficient strength to counteract shrinkage or expansion tendencies of the film.

7. An article of the character described comprising a celluloid strip having thereon a series of images representing successive time phases of an object-field, and fast to one side of said strip throughout the image regions a flexible band of material whose dimensions are substantially unaffected by moisture and which has sufficient strength to prevent substantial shrinkage or expansion of said strip.

8. An article of the character described comprising a celluloid strip having thereon a series of images representing successive time phases of an object-field, and a thin metallic ribbon continuously fastened to one side of said strip.

9. An article of the character described comprising a celluloid strip having thereon a series of images representing successive time phases of an object-field; and a thin metallic ribbon continuously cemented to one side of said strip.

10. An article of the character described comprising a celluloid strip having thereon

a series of images representing successive time phases of an object-field, and a thin metallic ribbon having a copper surface adhering to one side of said strip.

- 5 11. An article of the character described comprising a celluloid matrix having thereon a series of relief images representing successive time phases of an object-field, and fast to one side of said matrix throughout
10 the image regions a flexible band of material whose dimensions are substantially unaffected by moisture and which has sufficient strength to prevent substantial shrinkage or expansion of said matrix.
- 15 12. An article of the character described comprising a celluloid matrix having thereon a series of relief images representing successive time phases of an object-field, and a thin metallic ribbon continuously cemented
20 to one side of said matrix throughout the image regions.

13. The art of cinematography which comprises forming a cinematographic film of flexible material whose dimensions are substantially unaffected by moisture and which has sufficient strength to counteract shrinkage or expansion tendencies of photographic film, coating said flexible material with binding material, and sticking to said coating a photographic film. 20

14. The method of producing cinematographic film which comprises forming latent images on a photographic strip and subsequently mounting the strip on a flexible backing whose dimensions are substantially unaffected by moisture and which has sufficient strength to counteract shrinkage or expansion tendencies of the strip. 25

Signed by me at Boston, Massachusetts, this 28th day of December, 1922. 30

DANIEL F. COMSTOCK.