J. E. THORNTON.

APPARATUS FOR PRINTING CINEMATOGRAPH FILMS.

APPLICATION FILED NOV. 26, 1912.

1,160,671.

Patented Nov. 16, 1915.

2 SHEETS—SHEET 1.

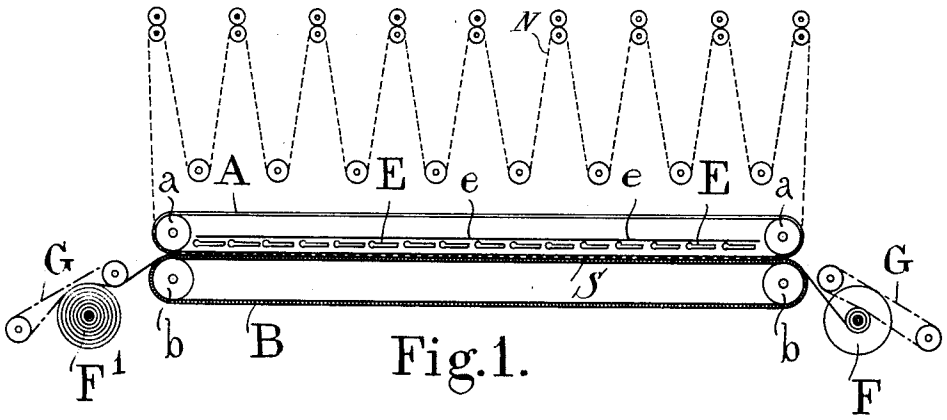


Fig.1.

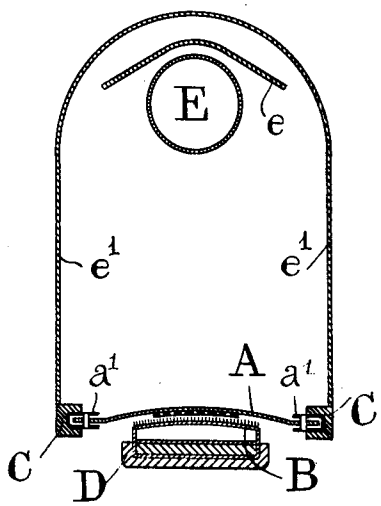


Fig.2.

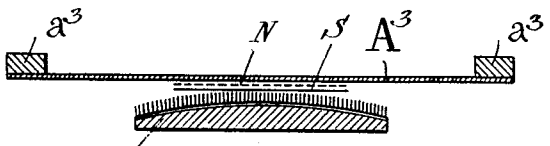


Fig.3.

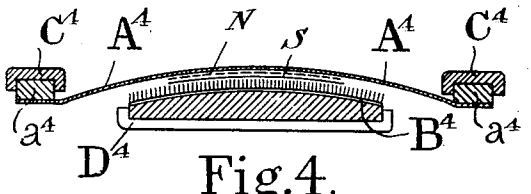


Fig.4.

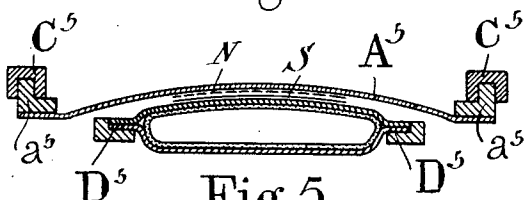


Fig.5.

WITNESSES.

Jacob Schechter.

Herbert H. Heise

INVENTOR.

JOHN EDWARD THORNTON,

BY Waldo G. Morse.

ATTORNEY.

J. E. THORNTON.

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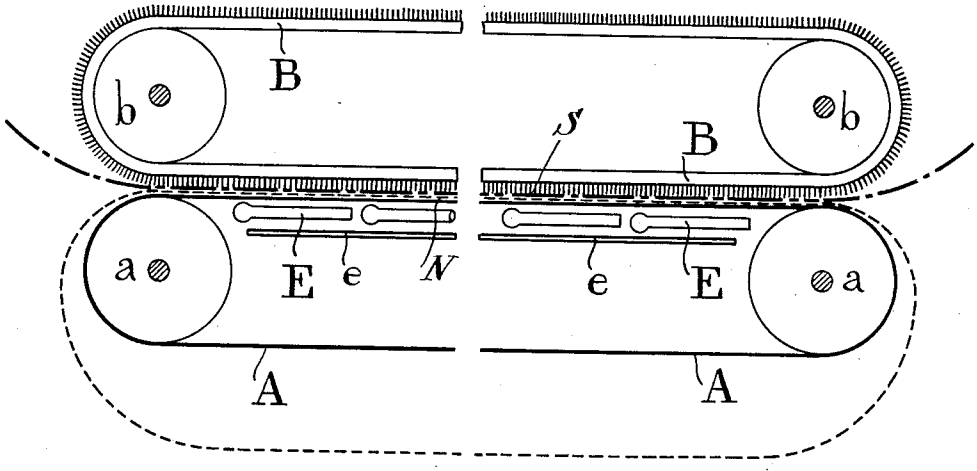


Fig.6.

WITNESSES.

Jacob Schechter.

Herbert H. Heise.

INVENTOR.

JOHN EDWARD THORNTON,

BY

Waldo G. Morse.

ATTORNEY.

UNITED STATES PATENT OFFICE.

JOHN EDWARD THORNTON, OF ROCHESTER, NEW YORK.

APPARATUS FOR PRINTING CINEMATOGRAPH-FILMS.

1,160,671. Specification of Letters Patent. Patented Nov. 16, 1915.

Application filed November 26, 1912. Serial No. 733,632.

To all whom it may concern:

Be it known that I, JOHN EDWARD THORNTON, a British subject, residing at Rochester, New York, United States of America, have invented certain new and useful Improvements in Apparatus for Printing Cinematograph-Films, of which the following is a specification.

This invention relates to the printing upon a long film of a series of photographic pictures for cinematograph or motion pictures to be projected onto a screen or otherwise employed.

The object of the invention is to provide mechanism for printing such pictures upon a long strip or tape of flexible material at a sufficiently rapid rate to be commercially useful in cases where the sensitive surface is of very slow printing value, such as when sensitized without silver salts. It is primarily intended for printing cinematograph or motion-picture films, but may be used for wider strips, such for instance as picture post cards, et cetera. Hitherto such pictures have generally been produced by means of rapid emulsions containing silver salts, one picture at an impression, and none of the machines generally used for such purpose would be commercially useful for material sensitized without silver, as they could not turn out enough to pay, on account of the long exposure necessary for every picture.

The invention therefore comprises a machine embodying the following features:—(*a*). A long length of film exposed at one time—say 100 or 200 feet or more. (*b*). A continuous forward movement of both the negative and positive films before, after, and during exposure. (*c*). Automatically applied springy or flexible pressure to maintain absolute contact between the negative and positive films during exposure. (*d*). Automatic repetition, producing print after print from the same negative (although the length of negative strip may vary for different subjects or editions) without removing or adjusting it until the entire edition required has been printed.

The invention consists essentially of a machine comprising two endless traveling bands or belts bent or curved transversely, one an opaque band or belt of a springy or flexible nature upon which the sensitized film or strip to be printed is placed, the other an endless transparent band or belt held tightly upon or against the opaque belt—the negative and the film being gripped between the two bands—, a channel or track-way along which the bands travel, suitable mechanism for giving the desired continuous and simultaneous movement to the bands, and lamps of high actinic but low heating power such as Cooper Hewitt mercury vapor electric lamps arranged to give a long narrow stretch of light longitudinally of the traveling films.

The invention will be fully described with reference to the accompanying drawings in which as example several forms of machine are diagrammatically shown.

Figure 1. is a longitudinal section. Fig. 2. is a transverse section on line *x*—*x* Fig. 1 drawn to a considerably enlarged scale. Figs. 3, 4 and 5 are transverse sections showing modified forms of the opaque traveling belt or band. Fig. 6. is a longitudinal section showing a modified arrangement of the traveling belts or bands with the lamps set below to project the light upward.

The two traveling belts or bands A and B are endless and are mounted on rollers *a* and *b* which are driven by any suitable gearing or mechanism to give an equal surface speed to the two belts the rollers *a* and *b* being supported by a frame of wood or metal not shown.

The belt A is transparent and is made of a flexible transparent material such as celluloid, cellulose acetate or gelatin sheeting of about .005 inch thickness, which must be free from scratches, joint-marks, or other blemishes. The central or useful portion may be about $1\frac{3}{8}$ to $1\frac{1}{2}$ inches wide, but the strip itself is wider and is secured at its unused edges to metal tapes, clips, slides, blocks, or other devices *a'* that run in perfectly true trackways C on either side, formed in the frame of the machine. The belt may be secured to these by pins, screws, or other means, but the clips are most convenient for permitting easy replacement of the transparent strip when desired. The belt A is so held as to be slightly slack in the center, thus tending to take a laterally curved or concave form, but stretched perfectly tight longitudinally.

The belt B is opaque and may be made of metal, leather, rubber, or other suitable material, and is formed with one side padded, to make a yielding springy cushion, of an outwardly curved or convex form laterally, though stretched perfectly tight longi-

tudinally. The belt B is carried in a flat channel shaped slide or trackway D which is perfectly rigid to prevent any sagging or displacement of the belt. The springy or cushion like nature of the upper surface of the opaque belt B causes it to remain in intimate contact with the belt A when no films or strips of material are between them and to grip and hold tightly together a negative film N, and a sensitized film or strip S of material when passed between them.

The two belts A and B are so mounted one above the other that the convex cushion of the opaque pressure belt B fits into the concave transparent belt A and with sufficient pressure to clamp them both in perfect contact. The pressure of the one belt against the other can be varied or made yielding, to compensate for inequalities. For instance the opaque belt B may be formed having a pile surface, such as plush, chenille, or the like, a rigid backing of metal or leather, and an intermediate yielding pad, such as a pneumatic cushion comprising a series of sealed air cells.

I at present prefer to construct the machine with the transparent concave belt A above or on top of the convex opaque pressure belt B as in Figs. 1 to 5, but the transparent concave belt A may be placed below the convex pressure belt B as shown in Fig. 6.

Adjacent to the transparent belt A (above or below it as the case may be) are placed a series of lamps E of high actinic and low heating power that preferred being Cooper Hewitt mercury vapor tube lamps of about 1000 candlepower each. Thus a streak of intensely brilliant light rich in ultra-voilet rays stretching longitudinally of the film is placed about six inches from the film or strip of material to be printed.

The lamps E are provided with reflectors *e* to throw as much light as possible on to the film, and are surrounded with an air trunk or casing *e'* (which may be conveniently formed by inclosing the sides of the machine framework with sheet metal), and through the trunk or casing *e'* a constant current of air is blown to carry away the surplus heat and keep the films reasonably cool.

At each end of the machine are placed reels F F' (as in Fig. 1) to carry the sensitized film or tape S of paper or other material upon which the pictures are to be printed. The reel F' pays off the sensitized strip and the reel F receives the strip as it is printed the reels being provided with suitable flanges to prevent the strip being displaced and to exclude light. The reels are driven by elastic friction bands G bearing lightly upon the surface of the material to give the same surface speed to both or by other driving mechanism, of any suitable type having compensating pull, such as a slipping belt for instance.

The reels may be of any suitable size say to carry from 10,000 to 20,000 feet of film. Or as in Fig. 6, the strip may be fed to the belts from any source and from the belts to any receiver. The two strips—the sensitive material S to be printed and the negative N to be printed from—are placed face to face, and introduced between the two belts A and B, the back of the negative being placed against the transparent belt, and are clamped together in perfect contact, while at the same time they are drawn forward over the streak of light from the lamps E. In this way, with an exposure of as long as from five to fifteen minutes to every section of the film, it is possible to turn out the printed strip at a commercially rapid rate.

Although a machine of 100 feet long is found sufficient for practical purposes, there is no limit, and 500 feet travel gives a very rapid rate of production.

By joining the two ends of the negative N it rotates as an endless belt, thus repeating the printing, upon the continuously moving sensitive tape. Where the negative film is longer than the machine it may be looped up in festoons as shown in Fig. 1.

To suit negatives of different densities the speed of the machine may be varied to give a longer or shorter time in the machine; or if preferred the exposure may be varied by cutting out some of the lamps, leaving the speed of the machine and film travel constant.

In Fig. 3 I have shown the belt A^3 as carried flat with slides a^3 secured to its upper face, and the belt B^3 is supported on a solid block.

The belt A^4 is shown in Fig. 4 with its slides a^4 running in tracks C^4 which are grooved on their lower sides. The belt is supported by a solid block carried in a trackway D^4.

As shown in Fig. 5 the belt A^5 carries angular slides a^5 engaging with tracks C^5, and the belt B^5 is double and is provided with a pneumatic cushion between its members, which in turn carry slides a^5, a^5.

What I claim as my invention and desire to protect by Letters Patent is:—

1. In apparatus for printing sensitized films or strips from a negative or positive film at a rapid rate, the combination of two traveling bands curved or bent transversely, one provided with a cushion surface between which the film and sensitive strip are placed, a trackway of channel shape to guide the bands and films, and a series of lamps, of high actinic and low heating power, placed to give a long narrow stretch of light longitudinally of the film.

2. In apparatus for printing sensitized

films or strips from a negative or positive film at a rapid rate, the combination of two traveling bands one translucent and the other opaque, said film being curved or bent transversely, one provided with a cushion surface between which the film and sensitive strip are placed, a trackway of channel shape to guide the bands and films, and a plurality of elongated mercury vapor lamps of high actinic and low heating power placed longitudinally end to end to give a long narrow stretch of light longitudinally of the film.

3. In apparatus for printing sensitized films or strips from a negative or positive film at a rapid rate, the combination of two traveling bands each curved or bent transversely, one provided with a cushion surface between which the film and sensitive strip are placed, a trackway of channel shape to guide the bands and films, reinforcing members along the edges of the transparent traveling band, and a plurality of elongated mercury vapor lamps of high actinic and low heating power placed longitudinally end to end to give a long narrow stretch of light longitudinally of the film.

4. In apparatus for printing sensitized films or strips from a negative or positive film at a rapid rate the combination of two traveling bands curved or bent transversely and between which the film and sensitive strip are placed, a trackway of channel shape to guide the bands and films, with a cushion covered with pile fabric upon the opaque band, and a plurality of long mercury vapor lamps, of high actinic and low heating power, placed end to end to give a long narrow stretch of light longitudinally of the film.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

JOHN EDWARD THORNTON.

Witnesses:
T. OWDEN O'BRIEN,
GEO. H. O'BRIEN.