J. E. THORNTON.

PHOTOGRAPHIC PRINTING APPARATUS.

APPLICATION FILED JUNE 8, 1915.

1,213,037.

Patented Jan. 16, 1917.

11 SHEETS—SHEET 1.

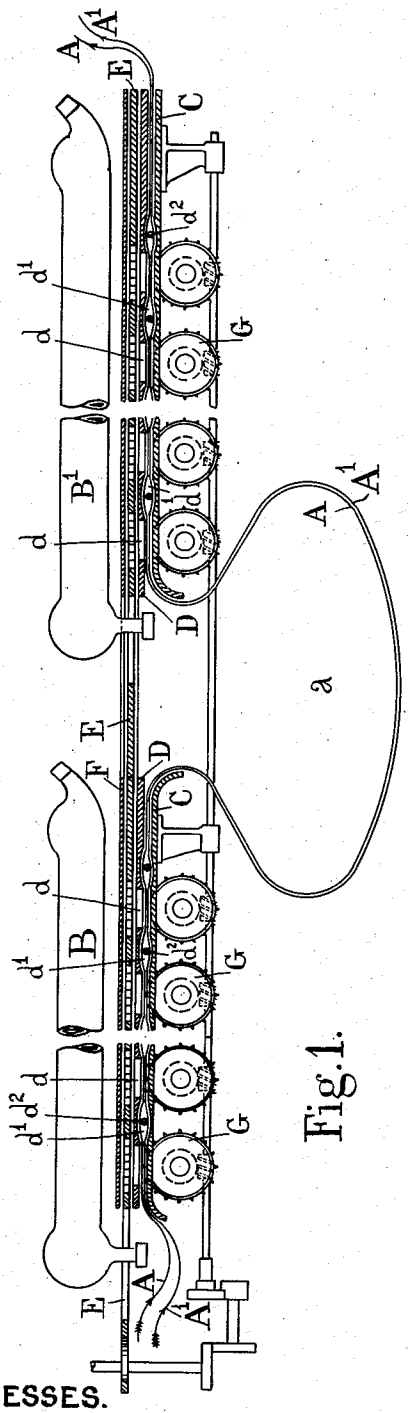


Fig. 1.

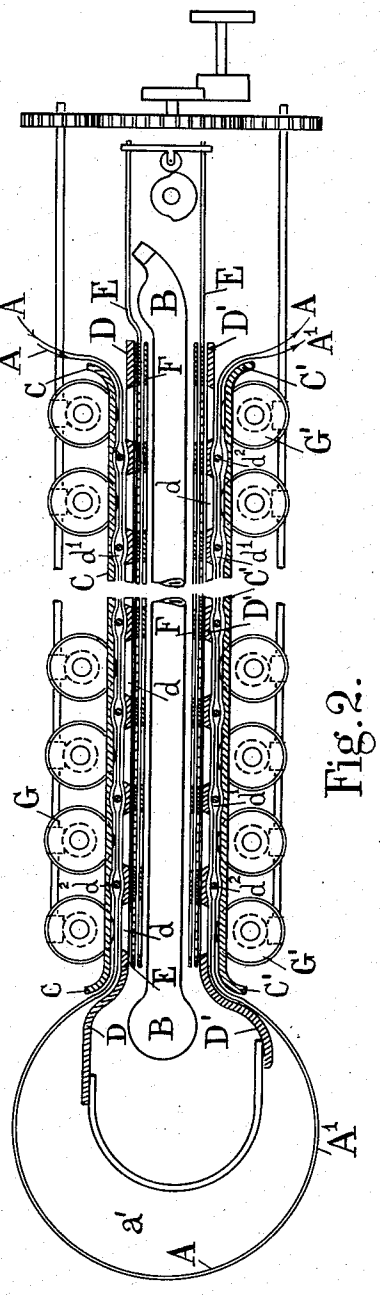


Fig. 2.

WITNESSES.

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INVENTOR.

J. E. Thornton

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Attorney

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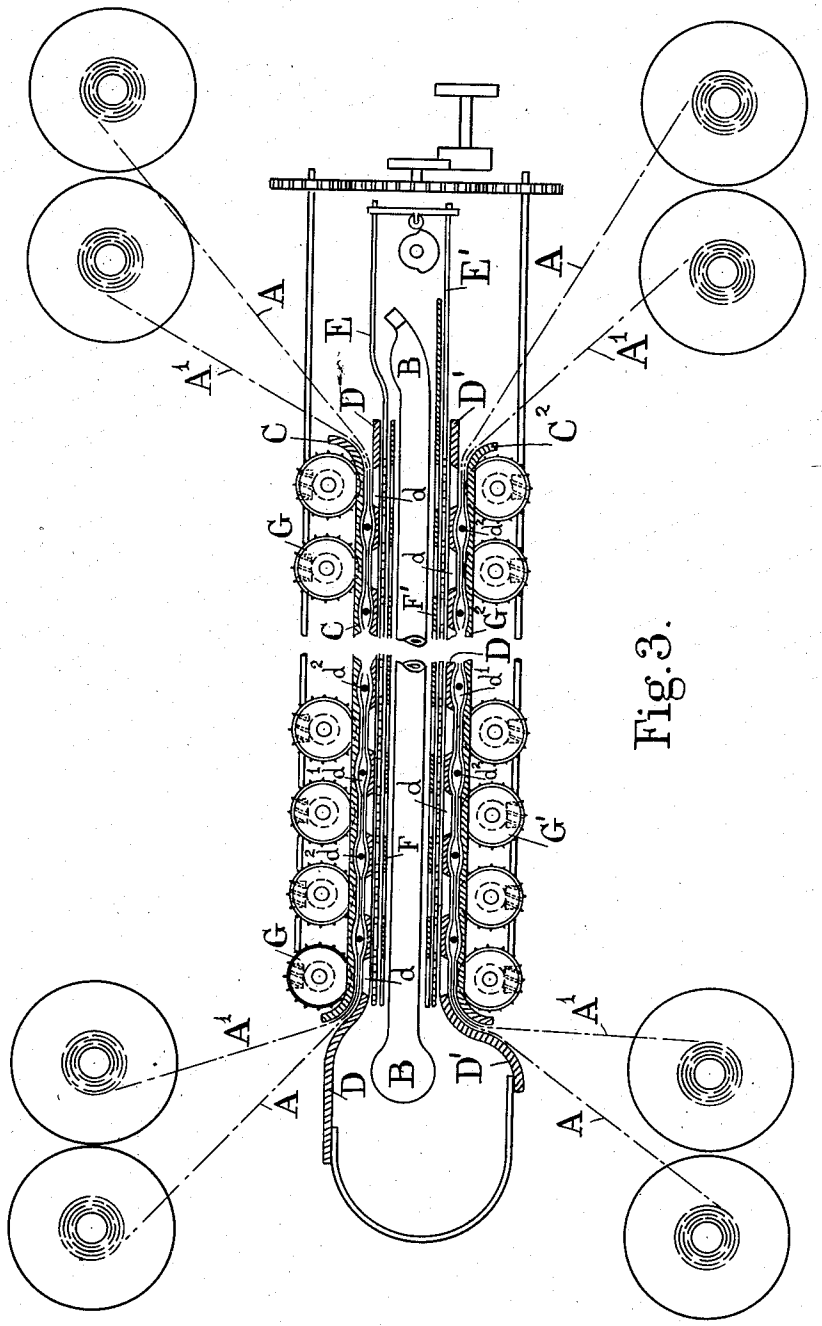


Fig. 3.

WITNESSES.

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11 SHEETS—SHEET 3.

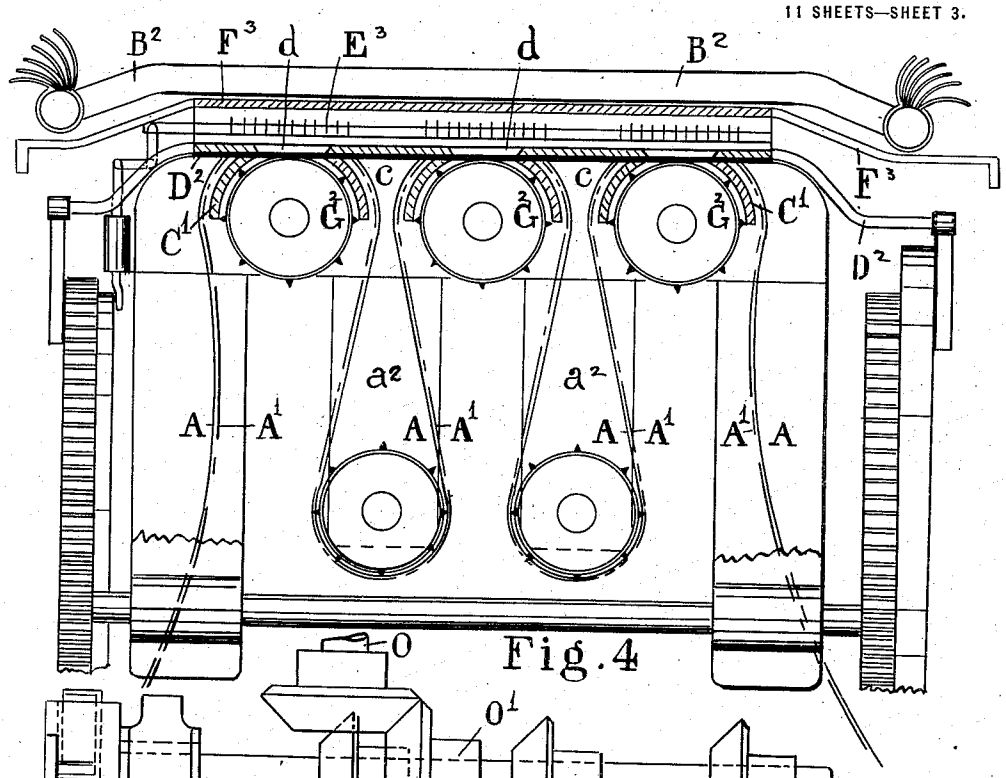


Fig. 4

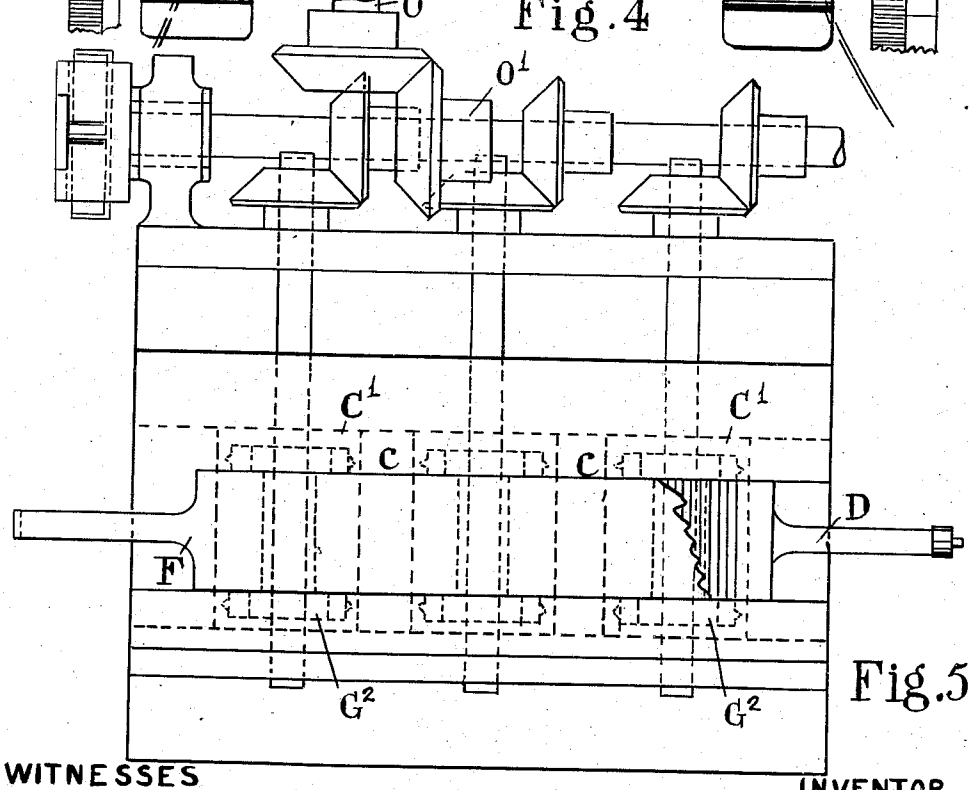


Fig. 5.

WITNESSES

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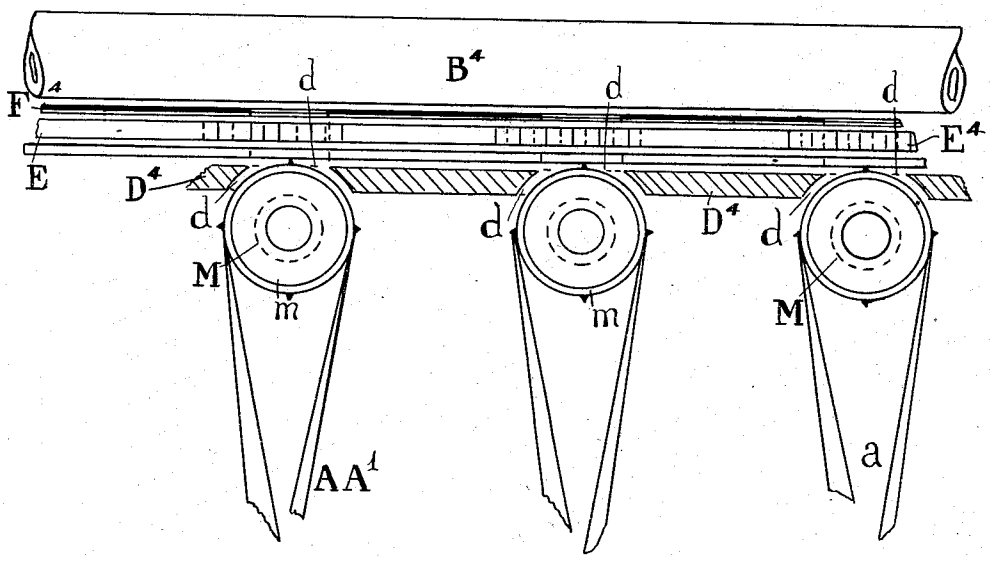
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11 SHEETS—SHEET 4.



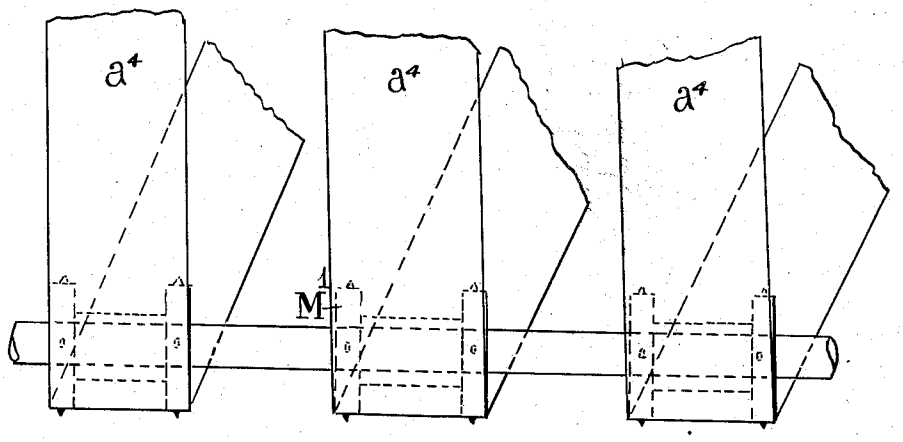


Fig. 6.

WITNESSES

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PHOTOGRAPHIC PRINTING APPARATUS.

APPLICATION FILED JUNE 8, 1915.

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11 SHEETS—SHEET 5.

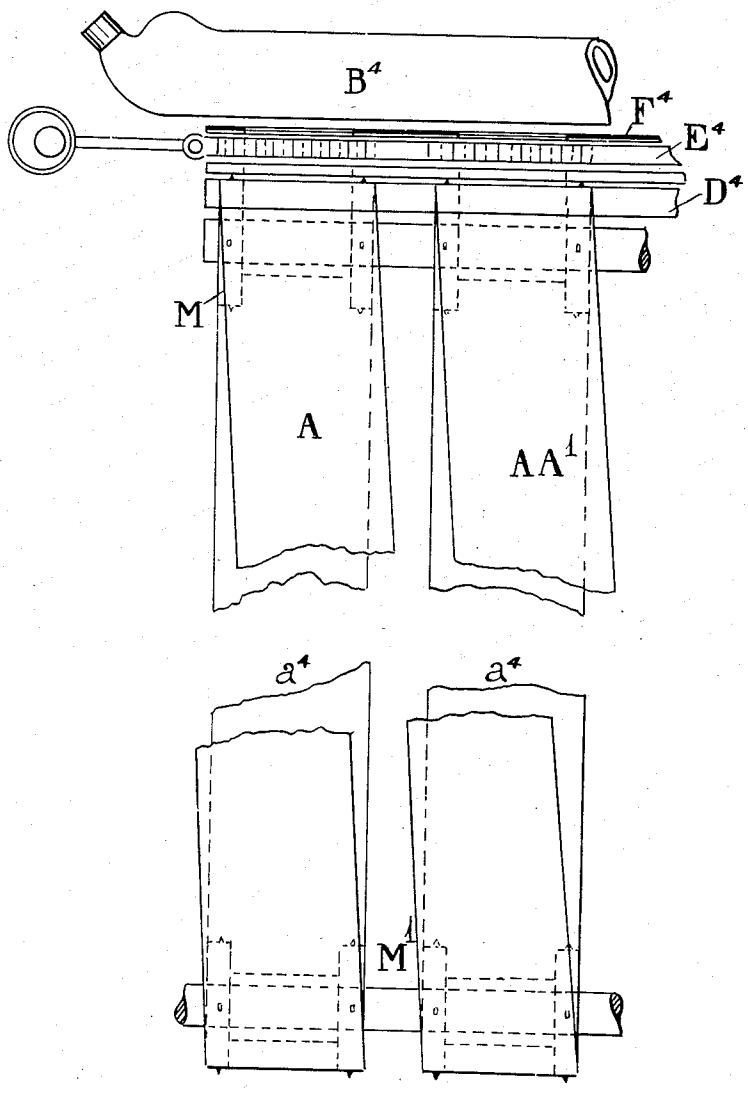


Fig. 7.

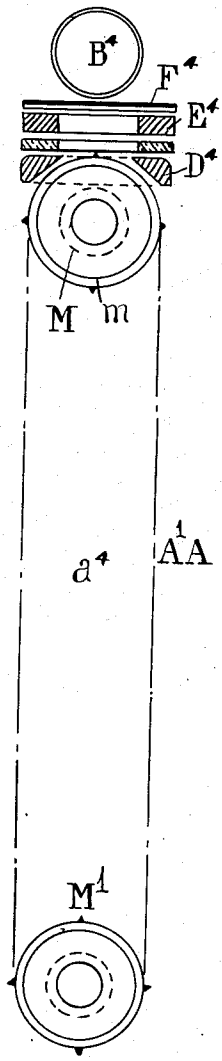


Fig. 8.

WITNESSES

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PHOTOGRAPHIC PRINTING APPARATUS.

APPLICATION FILED JUNE 8, 1915.

1,213,037.

Patented Jan. 16, 1917.

11 SHEETS—SHEET 6.

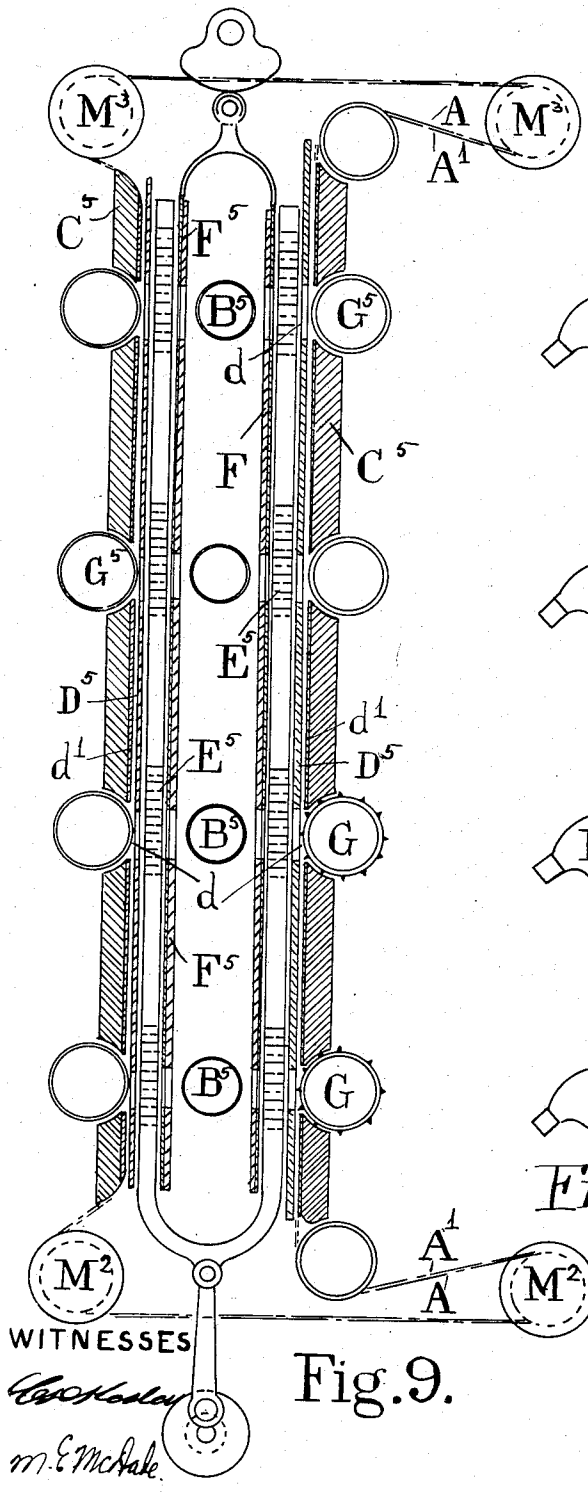


Fig.9.

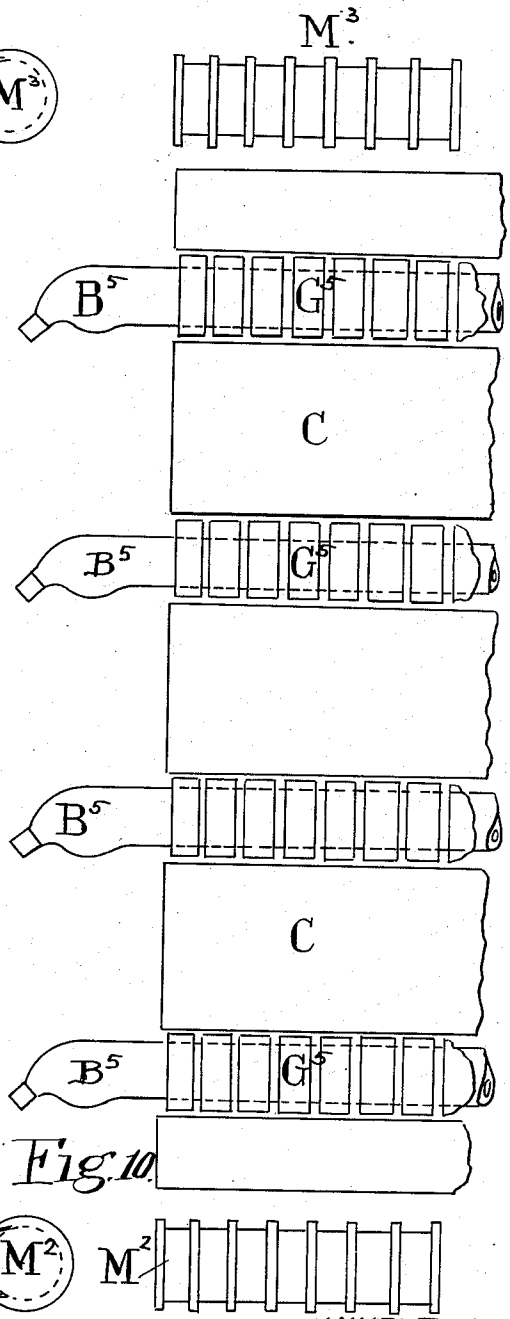


Fig.10.

WITNESSES

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PHOTOGRAPHIC PRINTING APPARATUS.

APPLICATION FILED JUNE 8, 1915.

1,213,037.

Patented Jan. 16, 1917.

11 SHEETS—SHEET 7.

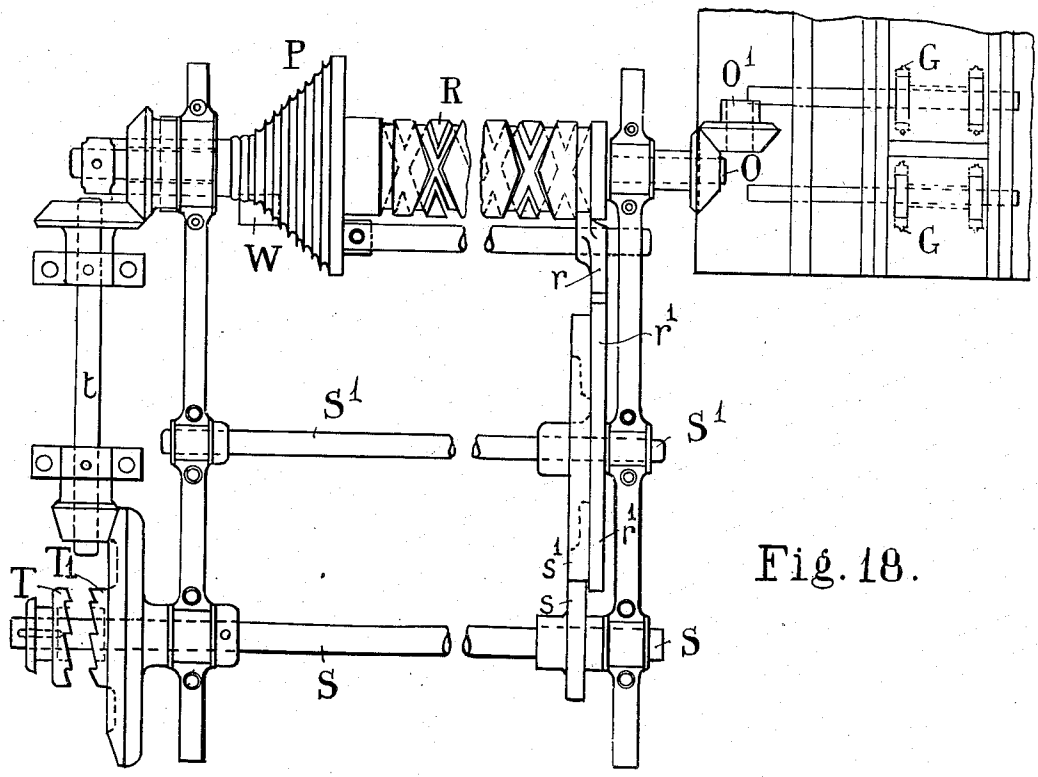


Fig. 18.

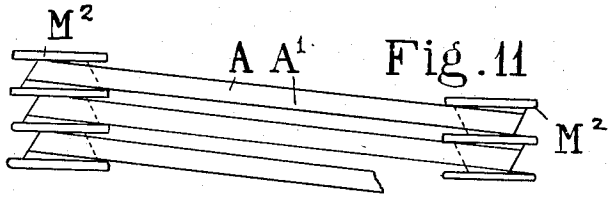


Fig. 11

WITNESSES

C. F. Kessler

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J. E. THORNTON.

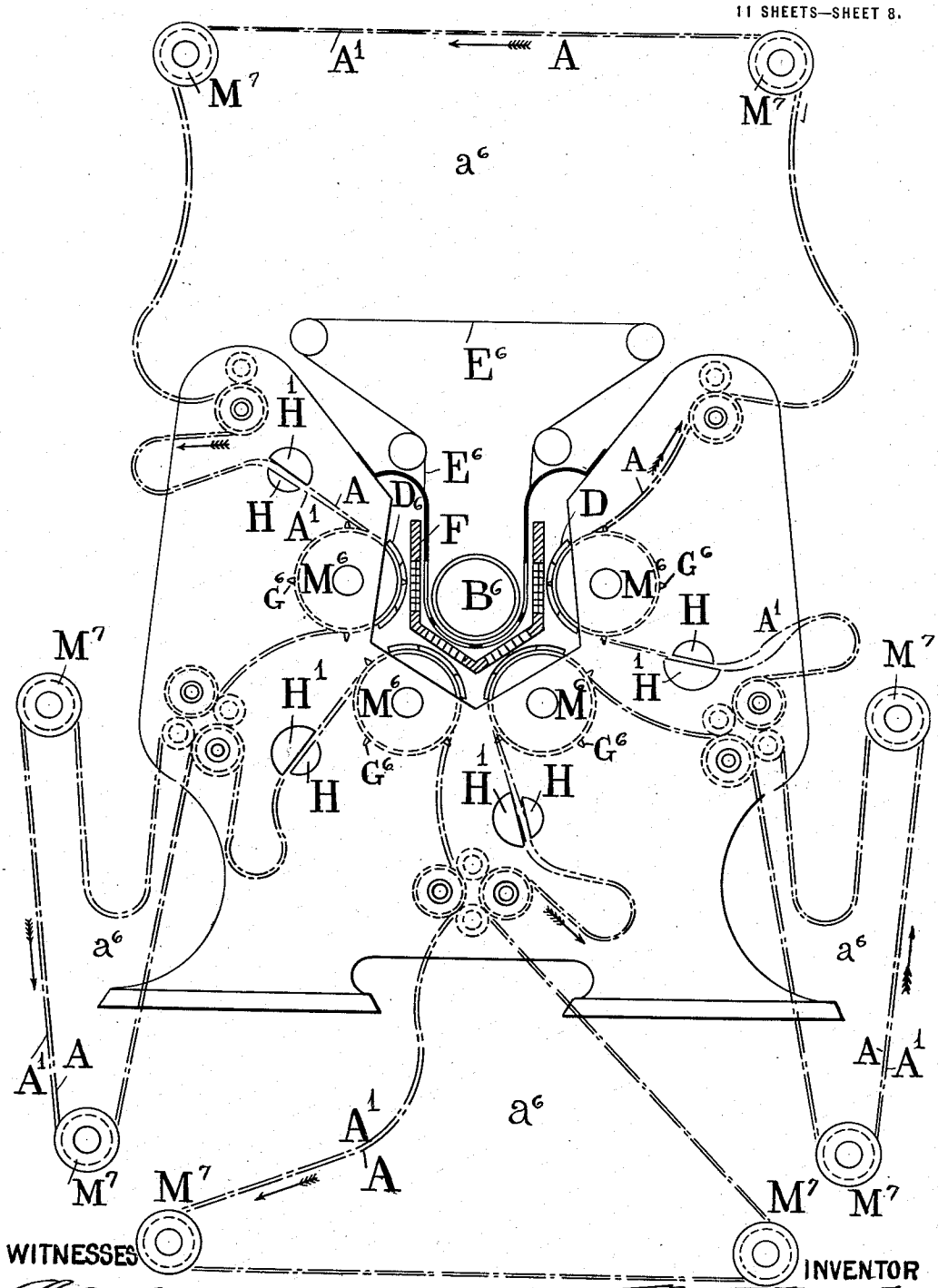
PHOTOGRAPHIC PRINTING APPARATUS.

APPLICATION FILED JUNE 8, 1915.

1,213,037.

Patented Jan. 16, 1917.

11 SHEETS—SHEET 8.



WITNESSES

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M. E. McDade

Fig. 12.

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PHOTOGRAPHIC PRINTING APPARATUS.

APPLICATION FILED JUNE 8, 1915.

1,213,037.

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11 SHEETS—SHEET 9.

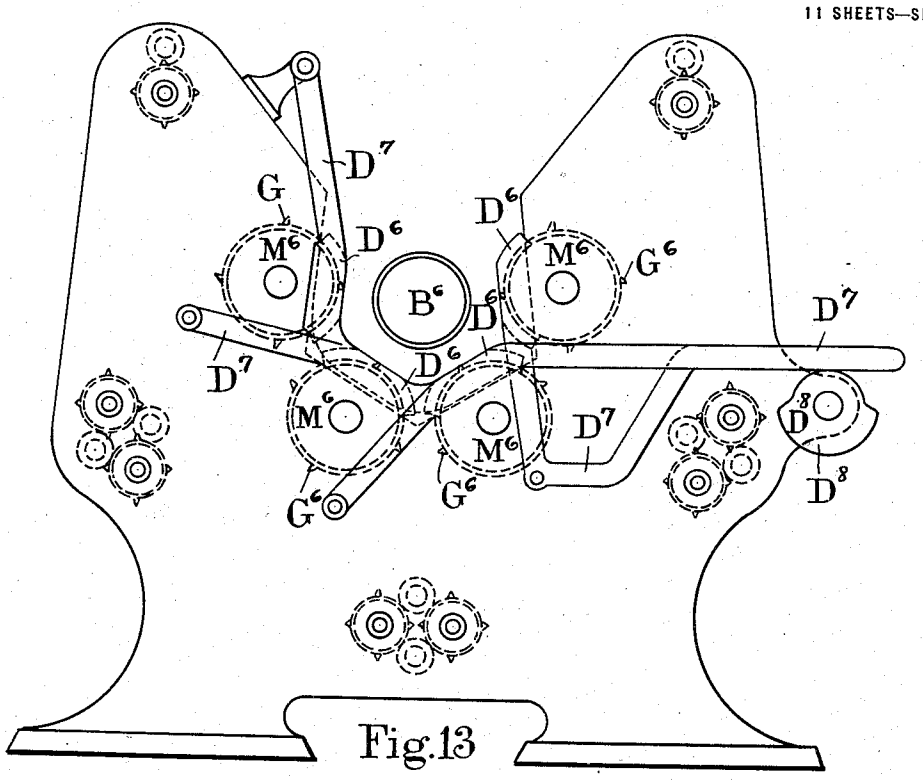


Fig.13

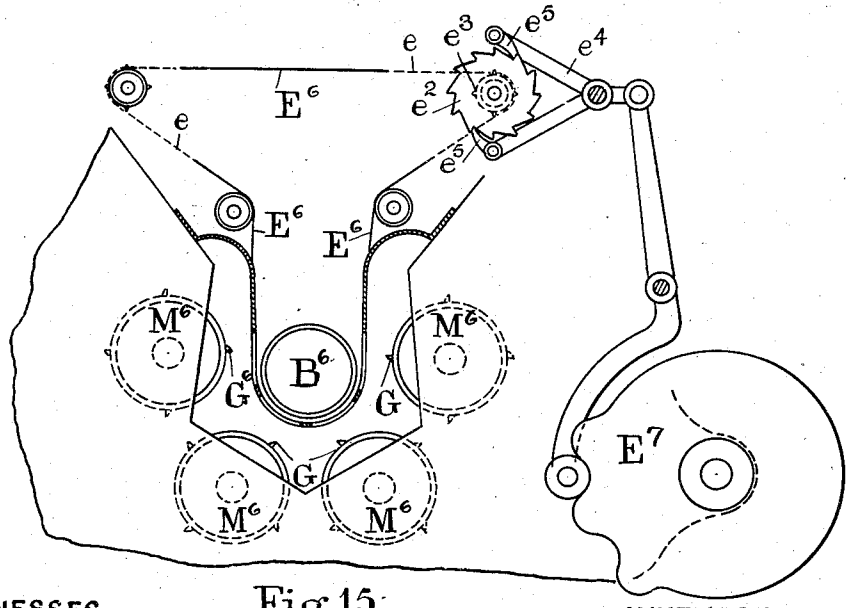


Fig.15.

WITNESSES.

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PHOTOGRAPHIC PRINTING APPARATUS.

APPLICATION FILED JUNE 8, 1915.

1,213,037. Patented Jan. 16, 1917.

11 SHEETS—SHEET 10.

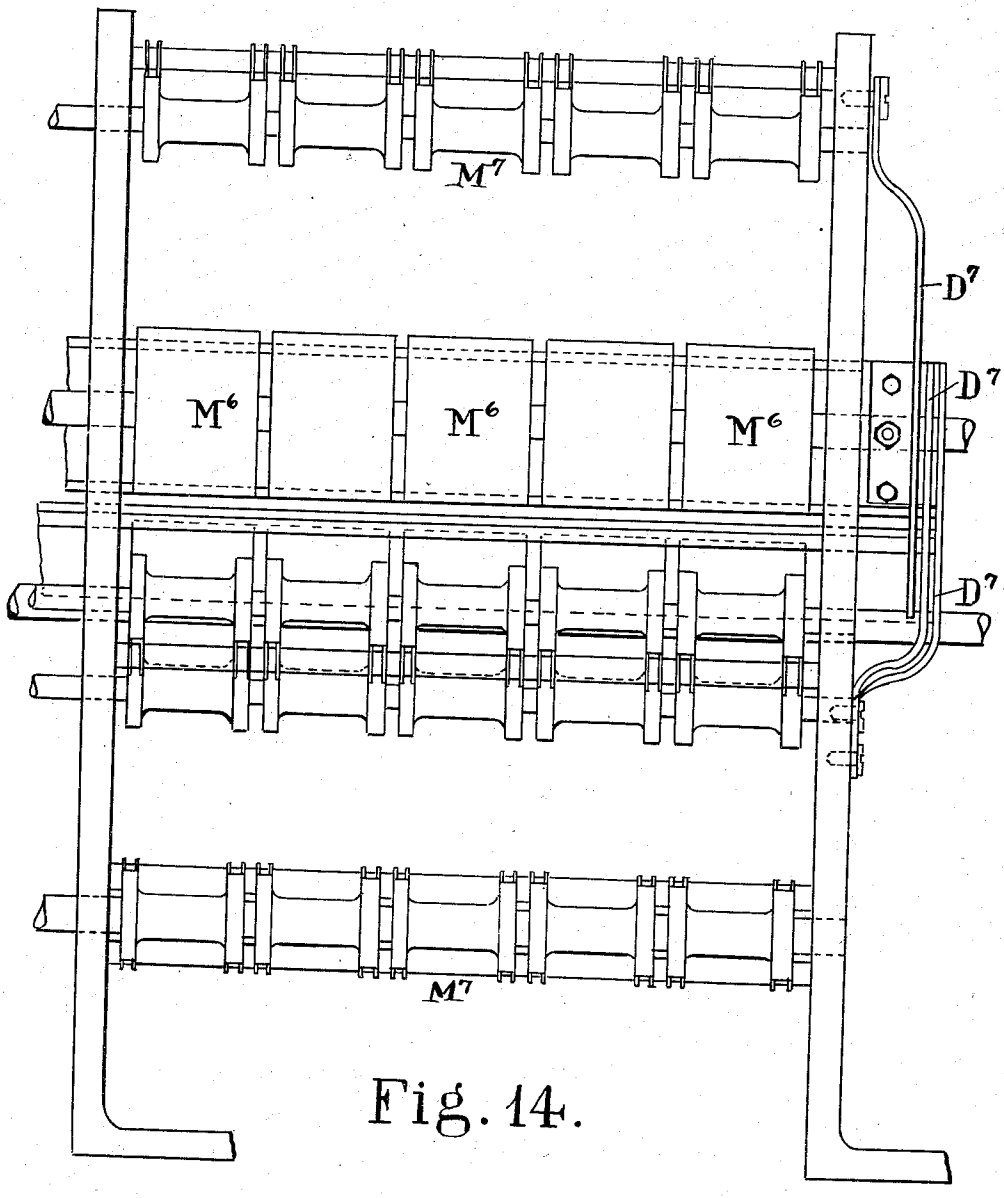


Fig. 14.

WITNESSES

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PHOTOGRAPHIC PRINTING APPARATUS.

APPLICATION FILED JUNE 8, 1915.

1,213,037.

Patented Jan. 16, 1917

11 SHEETS—SHEET 11.

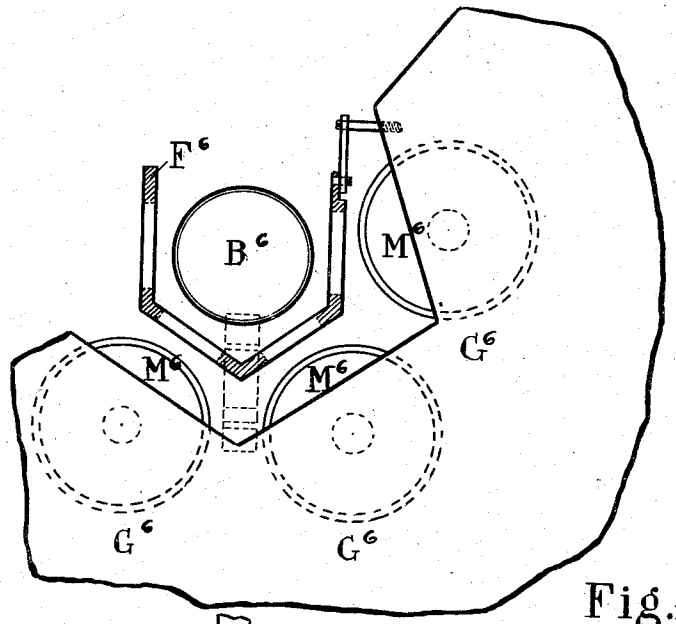


Fig.16.

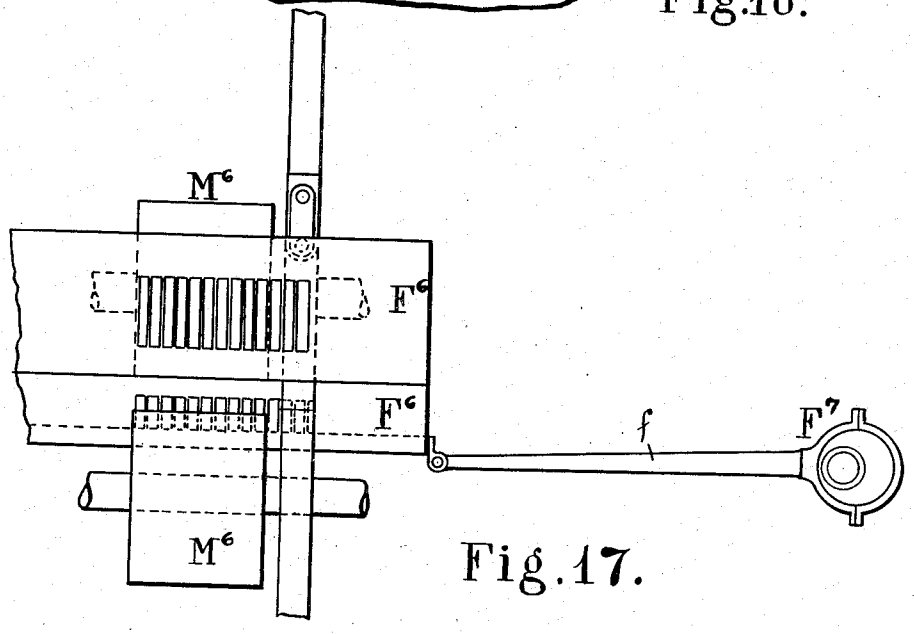


Fig.17.

WITNESSES

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Attorney

UNITED STATES PATENT OFFICE.

JOHN EDWARD THORNTON, OF WEST HAMPSTEAD, LONDON, ENGLAND, ASSIGNOR TO JOHN OWDEN O'BRIEN, OF MANCHESTER, ENGLAND.

PHOTOGRAPHIC-PRINTING APPARATUS.

1,213,037. Specification of Letters Patent. Patented Jan. 16, 1917.

Application filed June 8, 1915. Serial No. 32,949.

To all whom it may concern:

Be it known that I, JOHN EDWARD THORNTON, a British subject, residing at West Hampstead, London, England, have invented certain new and useful Improvements in Photographic-Printing Apparatus, of which the following is a specification.

This invention relates to the printing of cinematograph films (or other continuous strips such as post card paper) coated with an emulsion of low sensitiveness, such as those prepared with bichromate or iron salts.

In order to make the features of this invention clear, I will first describe the state of the art up to the most recent advance. Practically all the known methods of printing films of low sensitiveness (such as bichromate) at a rapid rate are those comprised in my prior applications Serial No. 733,632, filed November 26, 1912 and Serial No. 745,725, filed February 1, 1913, and Letters Patent No. 1,158,587, dated November 2, 1915 granted to me; and the whole series of such apparatus and methods differ extensively from what are suitable for printing films of high sensitiveness (such as silver). In the present state of knowledge of the art the methods are so different that the apparatus suitable for one system is useless for the other. In silver printing the pictures are printed through a picture gate or aperture of a size to expose one, two, or more adjacent pictures at a time, upon film that has been previously perforated. These perforations are used as the means for feeding the film through the printing machine with a step-by-step motion, and the exposures are made intermittently by a shutter, which passes light through the gate or aperture while the film strip is at rest and intercepts the light while the film is shifted a step forward. The exposure is very short (generally about a quarter of a second) and the intermittent movement of the film very rapid. A silver printing machine running at a normal rate will make about 8000 shift strokes per hour, thus turning out 8000 pictures, 16 to the foot, or 500 feet of printed film per hour. To do this a lamp of not higher than 50 candle power is necessary. But in bichromate printing as described in all my previous specifications referred to, the film is not printed one picture at a time, it is not intermittently shifted, there is no shutter cutting off the light intermittently, and the film is not perforated before printing. On the contrary a very large number of pictures (generally about 500) are exposed simultaneously, the film strip is moving continuously forward during the whole period of exposure, it is exposed to a fixed light of about 6000 candle power for a period of about 4 minutes, and the perforations have to be made after the film is printed, developed and dried. This method of perforation is absolutely necessary, because of the difference in length between the two strips of film (negative film and sensitive film) in a length of so many pictures. Without such system of perforating after printing, whereby the positions of the perforations are adjusted and placed to suit the relative positions of the pictures, it would be impossible to secure sufficiently accurate register for projection purposes. But in silver printing the reverse method is possible and regularly employed, that is to say, the pictures are adjusted and placed to suit the relative positions of the perforations.

From the foregoing descriptions of the main differences between the two systems of printing, the features of difference between the new method comprised in the present invention will be better understood.

The objects sought and accomplished by this invention are:—(1) In printing film of low sensitiveness (such as bichromate) to obviate the loss of time occasioned in urgent orders by having to make the perforations after printing and drying was finished, instead of before. (2) To find some satisfactory means of insuring accurate register when re-printing two, three or more images superimposed upon each other for multicolor work. This result can be secured (if the film is perforated beforehand) by using the perforations as means for registering, but cannot be done if there are no perforations. (3) While meeting the conditions of 1 and 2 to also insure about as large an output per machine per hour from film of low sensitiveness (such as bichromate) as is regularly obtained upon film of high sensitiveness (such as silver), although bichromate film requires approximately about 500 times as much exposure as silver film. These results are obtained by the following combination, worked out as indicated in this

specification:—(*a*) By retaining the principle of exposing a large number of pictures simultaneously to a fixed light, as in previous bichromate methods. (*b*) By substituting perforated for unperforated film. (*c*) By substituting intermittent film movement, and intermittent light by means of intermittent shutter, for the previously used continuous film movement, continuous light, and no shutter. (*d*) By introducing a loop or slack length (which may be long or short) between simultaneously printed pictures, so that no two adjacent pictures are allowed to print at the same exposure stroke, in order that those that are printed at the same time may each be independently placed and adjusted by registering pins or sprockets, each to its own correct position independently of any other. (*e*) Or by forming a film loop between each exposure or printing position, such loop having a length in picture spaces equal to the number of printing positions plus one over, the object of such loop being to provide sufficient film to contain as many pictures as there are printing spaces plus one, so that as the film is advanced one complete loop at every stroke each different picture impression is printed on a different loop, so that by the time the film has passed completely through the machine every space in every loop is filled with a printed impression, no part of the film being presented a second time to the light, and no double impressions made. (*f*) The same loop may be used for the purposes stated in paragraphs (*d*) and (*e*) although the functions of each are different. (*g*) By introducing a grid of vertical leaves, placed between the stationary light and stationary film, in order that all spreading light rays may be converted into perpendicularly acting ones such grid being given a continuous movement during exposure, in order to prevent its image from being impressed upon the film. (*h*) By combining these features in one unit apparatus and using a mercury lamp of about 6000 candle power an output of about 500 to 600 feet an hour of bichromate film can be printed the pictures appearing on the strip in progressive order and correct sequence.

The present invention is therefore designed to provide apparatus by which ready perforated films of low sensitiveness, such as bichromate, can be printed, in which accurate registration of the successive printings, single exposures of the pictures, a sufficiently long exposure, and a sufficiently rapid rate of production to be of commercial value are all secured.

The invention consists essentially in an apparatus for printing the film simultaneously at a number of points throughout its length—a single picture being exposed at each—and drawing forward after each exposure or each alternate exposure a length of film equal to the number of pictures printed—and in the particular disposition or arrangement of apparatus therefor; comprising a mercury vapor lamp or lamps; a bed, roller, or other carrier for the films; a shutter to cut off light from the film during its forward traverse; a moving grid to cause the light rays to strike the film perpendicularly; means for providing a loop or slack in the films between the points of exposure; and sprocket wheels, claws or other means for registering the perforations in the films and drawing them forward intermittently.

The invention will be fully described with reference to the accompanying drawings, in which various forms of carrying out the invention are shown in diagrammatic section.

Figure 1. Sectional elevation of apparatus with two mercury vapor lamps—of the Cooper Hewitt type—placed end to end, with printing bed parallel to the longitudinal axis of the lamp, a short slack length of film between each printing point, and a long slack length or loop of film between each lamp, alternate pictures being printed by the two lamps. Fig. 2. Sectional elevation of similar apparatus, with a single lamp, printing beds at both sides of the lamp, short slack lengths of film between each printing point, and a long slack length or loop of film at one end to permit of the film traveling from one side of the lamp to the other to print the alternate pictures. Fig. 3. Sectional elevation of apparatus similar to Fig. 2, showing the printing of two films simultaneously. Figs. 4 and 5. Sectional elevation and plan of similar apparatus, showing a high candle power mercury vapor lamp of the quartz type, and the film falling into a slack loop between the printing points. Fig. 6. Sectional elevation of similar apparatus, showing a mercury vapor lamp of Cooper Hewitt type and the film passing over a series of rollers, at each of which a space is printed, and falling into a long loose half twisted loop between the printing points. Figs. 7 and 8. Longitudinal and transverse sectional elevations of similar apparatus, showing mercury vapor lamps of Cooper Hewitt type, the film passing over top and bottom rollers parallel with the longitudinal axis of the lamp and falling into a long loose loop between the printing points. Figs. 9, 10 and 11. Vertical section, front elevation and plan of similar apparatus with a number of lamps placed between two flat beds, and transversely to the direction of travel of the film, with rollers or bobbins over which the film is carried in a spiral. Fig. 12. Sectional elevation of similar apparatus, with a single lamp placed

transversely of the travel of the film, a number of rollers grouped around it to present a corresponding number of printing points around the lamp, the film being carried in spirals around the lamp. Fig. 13. Transverse section of same showing the clamping plates D for securing the films in position. Fig. 14. Side elevation of same, enlarged. Fig. 15. Transverse section of same showing the shutter. Figs. 16 and 17. Transverse section and side elevation of same showing the grid. Fig. 18. Plan of mechanism for effecting the intermittent shift forward of the films.

The apparatus may be constructed in various forms to expose a number of non-adjacent picture spaces of the films, at a number of points throughout the length of the films, simultaneously to the action of a suitable printing lamp, and then intermittently draw forward the films to similarly expose an equal number of non-adjacent picture spaces, but always in such order that no picture space is presented more than once to the exposing lamp. A bed is mounted on a suitable frame or standard, upon or against which the sensitive film and the negative film are caused to travel. During exposure, the negative and sensitized films must be clamped together very closely to insure sharply defined prints, which is effected by movable clamping plates, or by putting a pulling tension on the films by any suitable tension device, preferably pneumatic suction.

In Fig. 1 a simple form of the apparatus is shown with two lamps B B′ of the Cooper Hewitt type set end to end and divided into two parts with a space or gap between them. It comprises a flat bed C upon which the films A and A′ are held during exposure to the light from the lamp B and over which they are caused to traverse; a clamping plate D, capable of moving to and from the bed A with exposure aperture d, by which the films are firmly and immovably held during exposure; a reciprocating grid E to cause the light rays to strike the film perpendicularly; and sprocket wheels G to engage the perforations of the films to draw them forward at intervals as required. The sprocket wheels G, to engage the perforations in the margins of the films, are mounted along both sides of the flat bed plate C, and are geared together to synchronize in their movement. To insure accuracy of registration, these sprockets should have the leading sides of their teeth straight, while the back sides may be beveled if desired. To these wheels an intermittent movement is imparted to traverse the film a predetermined distance and then allow it to remain at rest during the time necessary for the exposure and printing of the film. The clamping plate D is formed with exposure apertures d, with a space d' between them so that half the pictures are printed under the first lamp B and the other half printed under the second lamp B′, the film being traversed forward after each interval of exposure. The spaces d' in the clamping plate D between the exposure apertures are each of such a length and so formed concave or otherwise as to permit or cause a slack length or slight loop in the films, and thereby insure correct registration of the perforations in the films opposite each exposure aperture. To assist the movement of the films they may pass respectively over and under the pin d^2 fitted in the space d'. In the gap or space in the machine between the two lamps the films A A′ can fall slack into a loop a which will allow them to be drawn forward after each exposure a length equal to the number of pictures printed. A movable shutter F is fitted between the lamp B and the clamping plate D to cut off the light at every printing point or aperture during the traverse or shifting forward of the films. Instead of a separate shutter, the grid E may be made with spaces alternating with blanks and as it is moved from one position to the other performs the double function of grid and shutter. The lamp B may be of any of the various well known forms of mercury vapor lamps, according to the class of work the machine is intended to print.

In Fig. 2 a similar machine is shown with a single lamp B and two flat beds C, C′, one above and one below the lamp B, with a clamping plate D at one side and D′ at the other, and two sets of sprockets G, G′, to carry the films along two sides of the lamp. The exposure apertures d are formed in the plate D, the space d' being as before described to allow the films to adjust themselves to compensate for any differences consequent upon shrinkage or expansion in either of them and the perforations therein to register at each exposure aperture. The clamping plates D, D′, are similar to those in Fig. 1. Half the pictures are printed at one side of the lamp B and the other half printed at the other side of the lamp, a loop a' being formed at the end of the machine and the films being traversed forward a distance equal to the number of the pictures printed after each interval of exposure. The lamp B may be of any of the various well known forms of mercury vapor lamps, according to the class of work the machine is intended to print. Movable shutters F, F′, are fitted between the lamp B and the clamping plates D, D′, to cut off the light at every printing point or aperture during the traverse or shifting forward of the films. Insteaed of separate shutters, the grids E, E′, may be made with spaces alternating with blanks and as they are moved from one position to

the other perform the double function of grid and shutter.

In Fig. 3 the apparatus shown is similar to Fig. 2 but arranged to print two separate films simultaneously.

In Figs. 4 and 5 a similar machine is shown with the bed plate divided into sections C′ and gaps or apertures c therein through which the films can depend in slack loops a^2 to allow for adjustment or compensation thereof between each exposure aperture d in the clamping plate D^2, and the consequent registration of the perforations. The exposure apertures d are of a width to expose one picture at a time, so that three pictures will be printed at each exposure. The sprocket wheels G^2 are rotated from the shaft O through the wheels O′ by mechanism such as shown in Fig. 18. The loop a^2 is equivalent to the length of ten pictures, (although a loop the length of three pictures would be sufficient but is not used, as so short a loop would not give as good results as the longer one) and at each shift three pictures are moved forward at a time after each exposure interval thus bringing into the apertures three fresh pictures for exposure. In this case a high candle power mercury vapor lamp B^2 of the quartz type is shown. A movable shutter F^3 is fitted between the lamp B^2 and the clamping plate D^2 to cut off the light at every printing point or aperture during the traverse or shifting forward of the films. Instead of a separate shutter the grid E^3 may be made with spaces alternating with blanks and as it is moved from one position to the other performs the double function of grid and shutter. The sprocket wheels bands or claws are moved on intermittently the required distance by any well known form of intermittent motion. For high-grade accurate printing, and especially for printing in two or three colors by successive printings needing accurate register, I prefer a long lamp which will have a lower candle power per inch and be comparatively cool, such as the standard Cooper-Hewitt type of lamp, giving a light of 6000 candles in 66 inches length, or about 90 candle power per inch. But for very rapid or rush work, where a high standard of quality is not necessary, such as News Picture Films, I may use one of the mercury lamps of the quartz type, which are much higher in candle power, very short in length, but have a tremendously high temperature. Examples of these are known as the "Laboratory" of about 3000 candle power in 4 inches length, or the "Pistolet" of about 8000 candle power in 6 inches length. These quartz lamps are difficult and dangerous to use for printing on account of the ultra-violet or X rays given off, and their tremendous temperature, which the films will barely stand for the requisite printing time. But as they are useful for certain work, such a lamp is shown in Fig. 4 applied to one form of this printing apparatus.

In Figs. 6, 7 and 8 the apparatus is shown constructed to carry or suspend the films A and A′ in long loops a^4 between the exposure apertures d in the clamping plates D^4 and only one picture space is exposed at each aperture. The films A A′ are carried over a series of flanged rollers or bobbins M provided with sprocket wheels m by which the register of the two films is effected and maintained. The loops a^4 may pass in spiral form around a lower roller M′ similar to that described with reference to a printing, washing and developing machine in my U. S. Letters Patent No. 1,173,898 and No. 1,173,899, both dated February 29, 1916. The films may travel longitudinally of the lamp B^4 as in Fig. 6 and receive a half turn on to the bottom roller, or transversely of the lamp B^4 as in Figs. 7 and 8. The rollers M may form the supports upon which the films are tightly clamped during each exposure by the clamping plate D^4, or the bed plate may be formed as in Fig. 4. A movable grid E^4 and shutter F^4 are interposed between the lamp B^4 and the rollers M to direct the light rays perpendicularly to the films and to shut off the light when the films are being moved forward. The length of the loops a^4 in the films should be equal to the sum of the lengths of the pictures exposed and printed at one time. Thus with a Cooper-Hewitt lamp of 66 inches long it is possible to have 44 printing points and therefore 44 simultaneous exposures and 44 pictures on the film printed at one time. The film may thus be shifted an equivalent length after each exposure, that is to say that a film length of 44 pictures is printed every half minute or for every exposure.

In Figs. 9, 10 and 11 the apparatus is shown constructed to carry the films A and A′ backward and forward in a number of spirals transversely of a number of lamps B^5 four being shown. The films are wound around flanged rollers or bobbins M^2 and M^3 and pass between the flat bed C^5 and the clamping plate D^5 with exposure apertures d, a space d' to allow for a slackness in the films intervenes between the exposure apertures d. A sprocket wheel or roller G^5 engages the perforations in the films at each exposure aperture to register them. Each lamp B^5 may extend over 44 printing points or exposure apertures and four lamps will give 176 pictures printed at each exposure of 30 seconds, and allowing about an equal time for moving forward the film about 900 or 1000 feet of film may be printed in an hour. Movable grids E^5 and shutters F^5 are placed between the films and the lamps, as hereinbefore described. The lamps are so disposed and the spaces between them so ad-

justed to one another that no part of the film is exposed to light a second time. The apparatus may be disposed vertically as shown or horizontally.

In Figs. 12 to 17 the apparatus is shown constructed to pass the films circumferentially around a single lamp B^6, the film being passed spirally around the flanged bobbins or rollers M^6, adjacent to the lamp, with sprocket wheels G to engage the perforations in the films and bring the two films into correct register. Four sets of the bobbins or rollers M^6 are disposed around the lamp to present four printing points for every length of lamp equivalent to the width of the film, thereby providing $4 \times 44 = 176$ printing points. Clamping plates D^6 are pivoted and brought to and from the rollers or bobbins M^6 by levers D^7 actuated by a cam D^8, see Fig. 13, the bobbins being provided with registering sprocket teeth G^6. A shutter E^6 is placed around the lamp to shut off the light during the traverse of the films. This may be in the form of a blind with apertures e to allow the passage of light, to which a movement to and fro may be given by a ratchet wheel e^2 on a roller e^3 actuated by levers e^4 and pawls e^5 from a cam E^7, see Fig. 15. A grid F^6 is interposed between the lamp B^6 and the bobbins M^6, to which a longitudinal reciprocating movement is imparted by an eccentric or cam F^7 and connecting rod f, (see Figs. 16 and 17.) To retain the films in position on the bobbins M^6 it is desirable to lead them on with a certain amount of tension, and to effect this two suction boxes H H′ are placed in the path of the films over which the films are drawn by the sprockets G^6 and which will allow of registration of the perforations by the sprockets. The films A and A′ are carried forward in a series of loops a^6 spirally around the rollers or bobbins M′, see Fig. 12. When the films are passed over rollers or bobbins such as M^6, and a suitable tension applied thereto to maintain them in intimate contact when passing over the printing points, the clamping plates D^6 may in some cases be dispensed with.

The mechanism for effecting the shift or the intermittent forward movement of the films for any given length may be of any known mechanism. One disposition of gearing for gearing together the sprocket wheels G to G^6 is shown in Figs. 5 and 18 the intermittent gear connecting with the shaft O. The intermittent gear comprises a barrel P driven by a weight W, which descends when the barrel is released, (to insure a greater pull at the starting and lesser at the finish the barrel P for the weight cord is preferably of snail shape as used in a clock), a crossed worm R attached to the barrel with a retaining catch r which traverses to and fro across the worm, a cam plate r' to release the catch r and mechanism to rotate the barrel P in the reverse direction and rewind the cord of the weight upon it. A continuously running shaft S is mounted upon the frame of the apparatus and is geared by wheels s and s' to the shaft S′ which carries the cam plate r'. On the shaft at one end is a clutch with a member T fast to the shaft sliding on a key and a member T′ loose thereon. The loose member T′ of the clutch is geared through a shaft t and gear wheels with the barrel P with a free wheel or one way clutch mechanism which permits the barrel P to be rotated in the reverse direction to wind up the cord of the weight W thereon without rotating the shaft O. At the end of each exposure of the film the cam plate r' releases the catch r allowing the weight W to drop and causing the mechanism to rotate and through the bevel wheels O′ rotating the sprocket wheels thus moving the desired number of pictures before another exposure is made. The number of pictures and the length of film moved is governed by the length of the worm R and the period of the traverse of the catch r to and fro thereon. As soon as the catch r has traveled from right to left and back again it falls into the notch made for it and arrests further movement and rotation until released again by the next revolution of the cam plate r'. The weight W when its cord is unwound from the barrel strikes a lever (not shown) and throws the clutch member T into gear with the clutch member T′ to rotate the barrel P in the reverse direction to wind up the weight. A similar lever (not shown) is again struck by the weight W and throws the clutch member T out of gear with the member T′ when the weight is wound up.

In several of these arrangements the sprockets for carrying forward the films may be replaced by an endless band with sprocket teeth or pins projecting from its surface to engage the perforations in the films.

By this method of printing every printing point receives the same exposure, and no picture-section is presented to the light more than once, the film being so spaced and moved that the whole strip is exposed in succession. Light traps of plush or other material may be placed between the rollers or spools M to prevent the passage of light to the other portions of the films.

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

1. Apparatus for printing cinematograph films comprising a light of high actinic and low heating power, a bed over which the films travel, means to hold the films in intimate contact during each exposure with more than two exposure apertures and a plurality of spaces one between each pair of ap-

ertures, feeding and registering means to engage the perforations in the films to carry them forward, and a movable shutter interposed to cut off the light during the movement of the film, substantially as described.

2. Apparatus for printing cinematograph films comprising a light of high actinic and low heating power, a bed over which the films travel; means to hold the films in intimate contact during each exposure; a movable grid interposed between the light and the exposure aperture to cause the light rays to strike the film perpendicularly and thereby insure a sharp image; feeding and registering sprockets to engage the perforations in the films to carry them forward; and a movable shutter interposed to cut off the light during the movement of the film, substantially as described.

3. Apparatus for printing cinematograph films wherein a plurality of exposures, more than two, take place simultaneously, comprising means for forming a loop in the films in the plurality of spaces between each pair of exposure apertures to permit of registration of the perforations in the films, and means to intermittently draw the films forward after each exposure a distance equal to the number of pictures printed, substantially as described.

4. Apparatus for printing cinematograph films in which a large number of pictures are printed at a time and in which the films are exposed to the light of a mercury lamp tube at a number of printing points with loops between each printing point, means for bringing a picture section of the film to an exposure aperture adjacent to a lamp at each forward movement of the film; means for arresting the film opposite the exposure aperture for sufficient time to give the desired exposure; a grid; means for making such exposure through said grid, the grid being moved during the entire period of exposure, a shutter for cutting off the light, and means for finally shifting the film, during the period in which the light is cut off by said shutter, forward a distance equal to the number of pictures printed, in such a manner that no picture space shall appear more than once at a printing point, substantially as described.

5. Apparatus for printing cinematograph films, comprising a mercury vapor lamp; beds over which the films are passed in series of loops to present a number of printing points at intervals along the length of the film, means to maintain said films in intimate contact against said beds, said clamping means having a series of exposure apertures equivalent to the number of printing points, to expose all simultaneously, and a shutter to cut off the light while the film is shifted between exposures; and feeding and registering devices to engage the perforations in the film and feed the film intermittently forward a distance equal to the length of the number of the pictures printed, substantially as described.

6. Apparatus for printing cinematograph films, comprising a mercury vapor lamp; beds over which the films are passed in series of loops to present a number of printing points at intervals along the length of the film; clamping devices to maintain the films in intimate contact against said beds, said clamping means having a series of exposure apertures equivalent to the number of printing points, to expose all simultaneously; a moving grid which is kept moving between the lamp and films during the entire period of exposure; and a shutter to cut off the light while the film is shifted between exposures; and feeding and registering sprocket teeth to engage the perforations in the film and feed the film intermittently forward a distance equal to the length of the number of pictures printed, substantially as described.

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

JOHN EDWARD THORNTON.

Witnesses:

J. OWDEN O'BRIEN,

GEO. H. O'BRIEN.