PATENT SPECIFICATION

Application Date: April 12, 1926. No. 9578/26. **264,369**

Complete Accepted: Jan. 20, 1927.

COMPLETE SPECIFICATION.

Improvements in Color Cinematography.

We, TECHNICOLOR MOTION PICTURE CORPORATION, a corporation organised under the laws of the State of Maine, United States of America, and JOSEPH ARTHUR BALL, a citizen of the United States of America, both of 110, Brookline Avenue, Boston, Massachusetts, United States of America, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to the production of complemental cinematographic films preparatory to dyeing the films different colours for use as matrices in mechanical printing processes or to cementing the two films in superposition to form a composite film in natural colours.

The principal objects of the invention are to produce such films rapidly and economically, to expose the respective films simultaneously or at least concomitantly in the same operation or stage of the process, to expose the films in such manner that they may continuously pass into parallel juxtaposition after they are printed from suitable negatives, respectively to facilitate the registration of the films with relation to each other, to control the exposure of the films automatically both with respect to their average exposure and also with respect to their relative exposure, and in general to provide an improved method and apparatus for producing complemental films.

Other objects of the invention are to provide for concomitantly printing a plurality of positive films from a single negative film bearing plural series of complemental negatives, to provide means for advancing and registering the positive films in synchronism, to provide means common to the positive films for advancing and registering same, to increase the shutter efficiency of apparatus using a plurality of beams of light, and to provide means for automatically varying a plurality of printing lights relatively to each other.

The invention comprises feeding a plurality of films along angular paths, the angles of which are adjacent, the paths on one side of the angles extending in parallel juxtaposition or at least in the same general direction, and concomitantly forming complemental series of images on the respective films on the other side of the angles, as by printing from one or more negative films bearing complemental images. When the series of negative images are all on the same film the complemental images are preferably reversed with relation to each other, for example with their heads directed in opposite directions longitudinally of the film, as disclosed in Patent No. 194,971.

In any event the images are preferably formed on the positives in reversed relationship relatively to each other so that their heads are all directed in the same direction when the films pass into parallel juxtaposition as aforesaid.

If the positive images are to be converted into clear gelatin reliefs and subsequently stained different colors, the positive films are preferably printed through the backs so that the exposed portions of the emulsions are located next to the celluloid as disclosed in Patent No. 188,329. The present invention provides means for accomplishing this and at the same time permitting the films to be brought into parallel juxtaposition back-to-back after which they may be immediately cemented together and subsequently developed as disclosed in Patent No. 209,404.

The images of the respective series may be printed (or otherwise exposed) simultaneously or alternately. When exposing simultaneously, each image of a complemental set (a set comprising one image in each series) may be exposed at a time, or one image of one set and series and another image of another set and series, etc., may be exposed at the same time. However, it is important that the

[Price 1/-]

images printed at the same time (or in immediate succession) represent at least approximately the same time phase of the object field in order that the light for exposing the images of the respective series may be readily controlled to maintain the proper color balance between the images of the respective series. Consequently if the images of each set are not exposed simultaneously they should be exposed in close succession; and when printing one image of one set and series simultaneously with an image of another set and series, the images simultaneously printed should be in adjacent sets and preferably in sets representing succeeding time phases of the object field.

The aforesaid color balance is preferably maintained by automatically controlling the printing of the respective series in response to variations in the negatives, it being understood that the negatives vary in density throughout the length of the film owing to variations in light conditions, speed of the camera, etc. The variations in the negatives may be in the form of recesses in the edges at spaced intervals corresponding to the variations in density. The automatic control preferably comprises means for varying the light for each series in like manner, thereby to regulate the average exposure of the complemental positives, and also means for varying the light for the respective series in different manner, thereby to regulate the relative exposure of the complemental positives without substantially changing the average exposure.

The film gates or openings through which the complemental positives are exposed are preferably adjacent to facilitate the light control and the registration of the positives while being printed, the registering mechanism preferably being at least in part common to the positive films. In order to locate the film gates close together and at the same time shutter the light passing to the respective film gates simultaneously and quickly, the light paths preferably cross intermediate the lights and the film gates, in which case the shutter is located near where the light crosses so as to cover and uncover all the light paths with a minimum loss of time.

In order to illustrate the nature of the invention, one concrete embodiment has been shown in the accompanying drawings, in which:—

Fig. 1 is a front elevation of the principal parts of a printer embodying the invention;

Fig. 2 is a rear elevation of the printer;

Fig. 3 is a section on line 3—3 of Fig. 1;

Fig. 4 is a section on line 4—4 of Fig. 1;

Fig. 5 is a section on line 5—5 of Fig. 1;

Fig. 6 is a section on line 6—6 of Fig. 1;

Fig. 7 is a section on line 7—7 of Fig. 1;

Fig. 8 is a section on line 8—8 of Fig. 7;

Fig. 9 is a diagrammatic view illustrating the relationship between the printing lights and film gates;

Fig. 10 is a section on line 10—10 of Fig. 1;

Fig. 11 is a rear elevation of the mechanism shown in Fig. 10, as viewed from the left of Fig. 10;

Fig. 12 is a diagrammatic view of means for automatically controlling the printing lights;

Fig. 13 is a perspective view of films showing their relationship in the region of the film gates and showing one method of printing;

Fig. 14 is a similar view showing another method of printing; and

Fig. 15 is a similar view showing still another method of printing.

The particular embodiment of the invention chosen for the purpose of illustration is adapted to print from one negative N simultaneously upon separate positives P and P^1, the negative bearing two series of complemental images, one series being printed on positive P and the other series being printed on positive P^1. The negative film is fed from a suitable feed reel (not shown) downwardly over sprocket wheel R, thence through film tensioning means *a*, thence through film-gates G and G^1, thence downwardly over sprocket wheel F, thence over sprocket wheel B, and thence to the take-up reel (not shown). Between the film-gates G and G^1 a roller 7 is mounted on an eccentric shaft 8, as shown in Fig. 8, so that by rotating the shaft 8, the path of the film between the two film gates may be shortened or lengthened at will to bring the images of the negative into approximate registration with the respective film gates. The positive film P is fed downwardly from a feed roll (not shown) over sprocket wheel K, thence through film tensioning means a^1 thence through film gate G, thence over roller 1, thence under perforator 2 sliding in opening 2^1, thence over roller 3, sprocket wheel L, sprocket wheel n^1, and thence to the take-up reel (not shown). The positive film P^1 is fed upwardly from a feed reel (not shown) over sprocket wheel E,

thence over sprocket wheel X which is frictionally retarded by film tensioning means a^{11}, through film gate G^1, thence over roller 4, under perforator 5 sliding in opening 5^1 over roller 6, sprocket wheel J, sprocket wheel O, and thence to a take-up reel (not shown).

The mechanism for driving the movable parts of the printer are shown in Fig. 2 where C represents the main driving pulley actuated from an electrical motor or other source of power by a belt D, this pulley rotating shaft C^1 which carries a small gear 9 meshing with gear 10 keyed on shaft 11 (Fig. 5) which also carries the gear 12. Gear 12 is rotatably mounted on shaft 11 but is adapted to be clutched thereto by means of pins 13 movable longitudinally of the shaft by means of a groove sleeve 14 arm 15 and actuator 16 which is threaded on link 17 and held against the outer face of the casing Z by means of spring 18, whereby the clutch is thrown out by the spring 18 when the actuator 16 is threaded outwardly along the link 17. The gear 10 meshes with the gear 19 on the shaft of sprocket wheel F (Fig. 1) which in turn meshes with gear 20 on the shaft of sprocket wheel B (Fig. 1), this shaft carrying a smaller gear 21 meshing with a larger gear 22 on the shaft H. Mounted at the side of gear 20 is a beveled gear 23 meshing with beveled gear 24 on shaft 25 which in turn drives the sprocket wheel R (Fig. 1) through beveled gears 26 and 27. The aforesaid gearing serves to drive the negative through the medium of sprocket wheels R and F.

The driving mechanism for the positives comprises a gear 28 meshing with gear 12 and rotating on shaft D (Fig. 1), this shaft carrying the smaller gear 29 which meshes with gear 30 and drives the sprocket wheel E (Fig. 1). The gear 28 meshes with gear 31 on shaft I. Gear 31 drives gear 32 which actuates sprocket K (Fig. 1), also with gear 33 which actuates sprocket J, also with gear 34 which is mounted on shaft m. Shaft m carries a smaller gear 35 meshing with gear 36 which drives sprocket wheel n^1 (Fig. 1). Gear 36 meshes with gear 37 on the shaft which carries sprocket O (Fig. 1). This shaft also carries gear 38 meshing with gear 39 on shaft n. A pulley 40 is fast to gear 39 for driving parts of the machine not shown. Gear 31 carries on one side beveled gear 41 meshing with beveled gear 42 on shaft 43 which drives shutter S. Shaft 43 carries a cam having three cam grooves 44, 45, 46 for purposes hereinafter described.

The sprocket wheels F, J and L are driven intermittently through Geneva movements F^1, J^1 and L^1 (Fig. 1), these movements having the usual fly-wheels e, j and l shown in Fig. 2.

The mechanism for accurately positioning the films in the film gates comprises pressure plates Q and Q^1 mounted on tubular shaft 47 through arms 48 and 48^1 (Figs. 7 and 8). The shaft 47 has an arm 49 extending in the opposite direction from arms 48 and 48^1 and on the end of arm 49 is a cam roll 50 disposed in the cam groove 44 above referred to. The registering mechanism also comprises registering pins 51 which slide in guides 52 and are actuated by arms 53 mounted on tubular shaft 54, this shaft having an arm 55 carrying a cam roll 56 working in cam groove 45.

As above stated, the films are tensioned by any suitable tensioning means such as indicated generally at a, a^1 and a^{11} and in order to release this tension just prior to the advance of the registering pins 51 into the sprocket holes of the films, the following mechanism is provided: The rollers 3 and 6 are mounted on a dovetail slide 57 sliding in a fixed guide 58. This guide is connected through link 59 to the upper end of arm 60 pivoted at 61 (Figs. 1, 6, 7 and 8). The upper end of this arm carries a cam roll 62 working in cam groove 46. The lower end of arm 60 carries a roller 63 (Fig. 1) bearing against the negative film N beneath the film gates. When the arm 60 is oscillated in a counterclockwise direction (Fig. 1) the rollers 3 and 6 move to the left and the roller 63 to the right, thereby releasing the tension on the three films.

The cams 44, 45 and 46 are timed so that the parts operate in the following sequence: After the films stop the registering pins begin to advance, and after the tapered forward ends of the pins pass through the sprocket holes the tension is released, and after the pins are fully inserted the pressure plates Q and Q^1 are advanced to press the films in flatwise contact. After the images are printed, the pressure plates retract, the registering pins retract and the tension is re-established.

Separate lights U and V are provided for the respective film gates, the paths of which cross as shown in Fig. 9. These lights are enclosed in a lamp house (not shown) located at the left of Fig. 1 and the light paths are enclosed by means of a casing formed in two parts 64 and 65, the part 65 telescoping into the part 64 to facilitate threading films through the film gates. A partition 66, having a central opening 67, is provided imme-

diately in advance of the shutter S and the lights are so positioned that their beams cross at the opening 67. This permits the lamps U and V being placed farther apart and also permits a single shutter to shutter both beams substantially simultaneously, the shutter being placed at or near the place where the beams cross.

The mechanism for controlling the lights U and V, as illustrated in Figs. 10, 11 and 12, is constructed as follows: The lamps are connected to a source of current 68 through variable resistance 69 and 70. Taps from the resistance coils 69 and 70 connect with vertical bars 71 which have a series of openings to receive contact plugs 74. A contact bar 72 slides vertically in guides 73 in juxtaposition to the bars 71 so as to contact with plugs such as indicated at 74 in the openings 75. The circuit for the lamps is as follows: From one side of the source of current through conductor 76, thence through resistance 69, thence through one of the bars 71 to a plug 74 contacting with bar 72, thence through bar 72 to a plug 74 connecting with one of the taps of resistance 70, thence in parallel through the resistance 70 and lamps U and V back to the source of current through conductor 77.

The bar 72 is arranged to be stepped downwardly by means of an escapement mechanism 78 controlled by magnet 79 and switch 80. The switch 80 comprises two parts 81 and 82, the part 82 comprising an arm pivoted at 83 and carrying at its lower end a roller 84 rolling on the edge of the negative film N. The negative film is provided with notches in this edge at predetermined intervals and as one of these notches passes under roller 84, arm 82 moves in a clockwise direction (Figs. 10 and 12) closing switch 80 momentarily. This operates the escapement mechanism to step the bar 72 down one row of openings in the bars 71.

Notches are provided in the negative film at the points where the average intensity of the two printing lights should be varied and also at points where the relative intensity of the two printing lights should be varied. The plugs 74 are arranged in the left-hand bank of bars 71 in accordance with the desired variation in the average intensity of the printing light and the plugs are arranged in the right hand bank of bars 71 in accordance with the desired variation in the relative intensity of the lights U and V. When it be desired to vary the average intensity without varying the relative intensity, succeeding plugs in the left-hand bank are laterally offset from each other while the plugs in the corresponding rows of the right-hand bank are placed one above the other, and vice versa. Consequently when the bar 72 moves downwardly from one plug to another plug laterally offset from the first plug, one of the resistances 69 and 70 is varied to control the average or relative intensity of the printing lights respectively.

In Fig. 13 one method of printing the complemental images is illustrated in which the negative film N carries pairs of images F_4, F_5, F_6, etc., of which the images of each pair are arranged foot-to-foot in symmetrical reversed relationship longitudinally of the film, T and W represent the printing lights for the respective images, this figure as well as Figs. 14 and 15 illustrating the possibility of using separate lights without crossing their paths although it is to be understood that the paths may be crossed as above described. In Fig. 13 the images of each complemental set, which are juxtaposed, are printed simultaneously at equal distances from opposite sides of the horizontal plane between the juxtaposed portions of the positives P and P^1. In thus printing juxtaposed images it will be understood that the film gates should be juxtaposed or made in the form of a suitable double-size film gate instead of being separated as above described.

In Fig. 14 the arrangement is that of the embodiment above described in detail except that the paths of the printing lights are not shown as being crossed. With the film gates separated by two intervening picture spaces an image of one pair of complemental images is printed in the lower film gate at the same time that a different image of another set is printed in the upper film gate. As shown in Fig. 14 the images printed simultaneously are in adjacent complemental sets, the inverted image of set three being in printing position in the lower film gate while the upright image of set two is in printing position in the upper film gate. With this arrangement the images of each complemental set do not register with each other when the films pass into parallel juxtaposition if the horizontal plane between the juxtaposed portions of the positives is half-way between the two film gates. On the contrary the upper positive P is one picture space ahead of the lower positive P^1. In such case the perforators 2 and 5 are employed to perforate the respective films at corresponding points, as for example, imme-

diately before or immediately after the series of images are printed; for example, after the machine has been threaded, the perforators 2 and 5 may be pressed toward the films to perforate same before the machine is started. With these perforators spaced apart a distance equal to one picture space, they will perforate the respective positives at corresponding points so that if the films are subsequently started through a cementing machine (such as described in Patent No. 238,445) with the perforations in registry, the complemental images will register with each other.

If it is desired to have the film gates separated and at the same time have the complemental images register with each other when the positives are brought into parallel juxtaposition, the paths of the positive films from the film gates may be made of different lengths as for example by the use of rollers 85, 86 and 87 as shown in Fig. 15, the path of the upper positive being made sufficiently longer to bring the complemental images in registry beyond roller 87.

At times it is desirable to advance the negative film without advancing the positive films, as for example when it is desired to omit a section of the negative film. With the present machine this can be accomplished without unthreading the films, merely by throwing out the clutch 16, advancing the negative the desired distance and then throwing the clutch in again.

For the sake of simplicity and clarity the film printed from is herein referred to as the negative and the films printed upon are referred to as positives. However, it will be understood that inasmuch as negatives can be printed from positives equally well according to the present invention, as for example in making negatives from master positives as in certain known processes, the terms negatives and positives are to be construed illustratively and not definitively.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. The method of making complemental cinematographic films preparatory to dyeing the films different colors for use as matrices in mechanical printing processes or to cementing the two films in superposition to form a composite film in natural colors, characterized by feeding a plurality of blank films along angular paths the angles of which are adjacent the paths on one side of the angle extending in the same direction and concomitantly forming complemental series of images on the respective films on the other sides of the angles.

2. The method of Claim 1 further characterized in that the centre lines of the two films are parallel to each other on each side of the angles.

3. The method of either of the preceding claims further characterized in that the emulsion sides of the films are on the inner sides of the angular paths and the emulsions are exposed through their backs from the opposite side.

4. The method of any of the preceding claims further characterized in that the paths of the films on one side of said angles lie in the same plane and the films are exposed in said plane.

5. The method of any of the preceding claims further characterized in that the images of each complemental set are formed on said films in reversed relation to each other longitudinally of the films on the side of said angles where the films feed toward the angles so that the images are directed in the same direction when the films pass into parallel juxtaposition on the other side of said angles.

6. The method of any of the preceding claims further characterized in that the images are so positioned on the respective films that corresponding points of each corresponding pair register when the films pass into parallel juxtaposition.

7. The method of any of the preceding claims further characterized in that the images on each film are formed by printing light and the printing light for each film is automatically varied in proportion to variations in the average density of the corresponding series of printing negatives.

8. The method of any of the preceding claims further characterized in that the relative exposure of each complemental series is automatically varied substantially independently of the variation recited in Claim 7.

9. The method of any of the preceding claims further characterized in that said series of complemental images are printed respectively from complemental series of negatives on a single negative film, one positive film traveling in the same direction as the negative and the other positive film traveling in the opposite direction.

Dated the 12th day of April, 1926.

WM. BROOKES & SON,
London & Lancashire House,
5, Chancery Lane, London, W.C. 2,
Chartered Patent Agents.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1927.

[This Drawing is a reproduction of the Original on a reduced scale.]

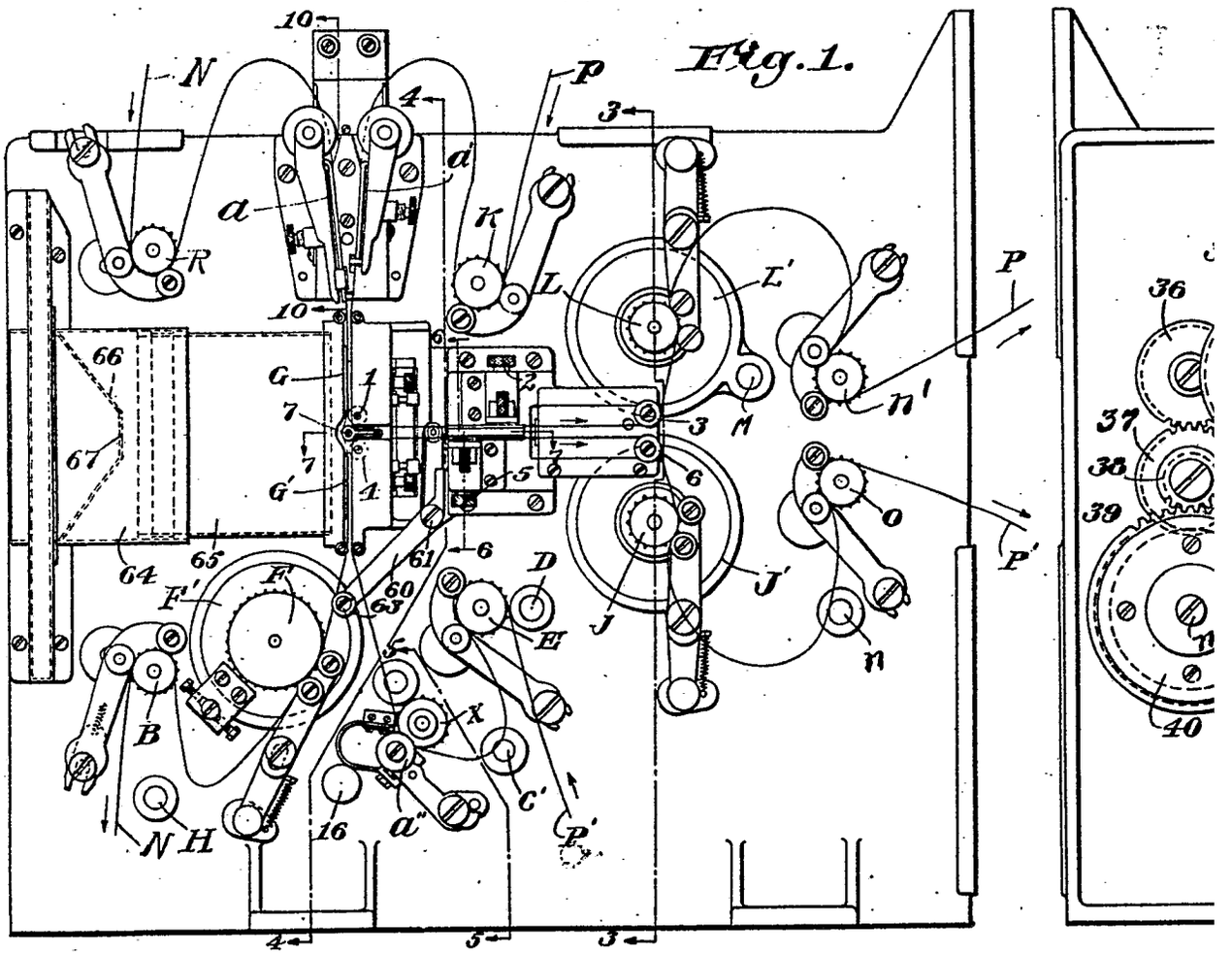

Fig. 2.

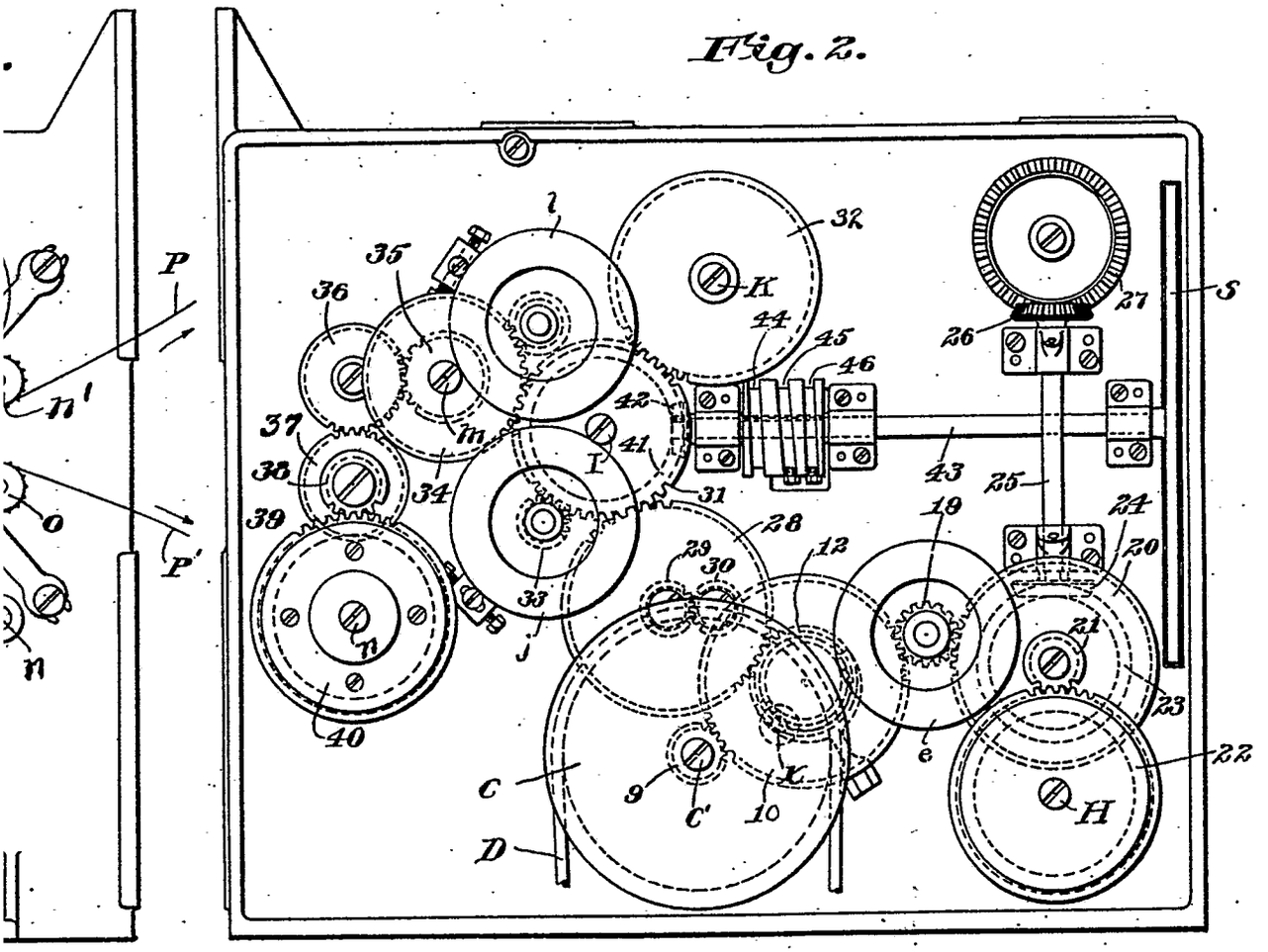

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Fig. 1.

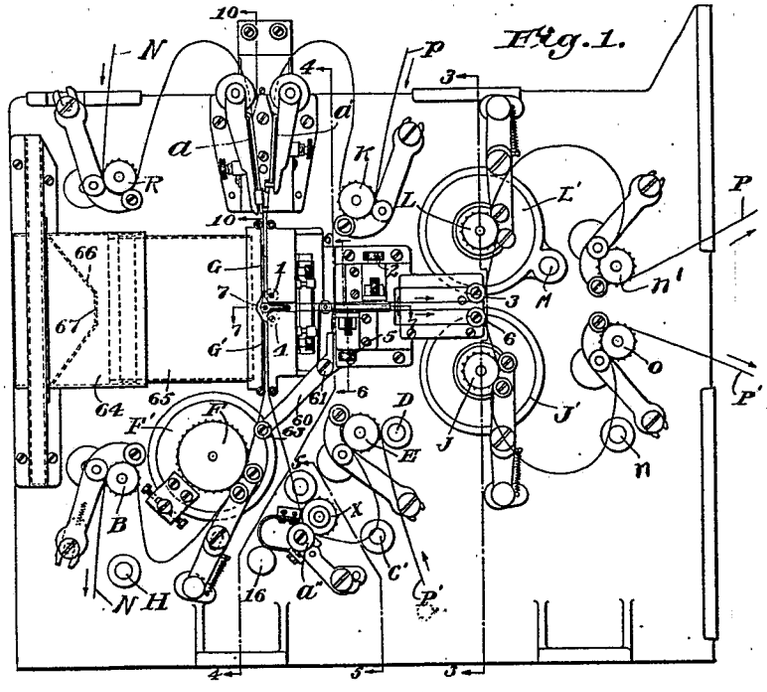

Fig. 2.

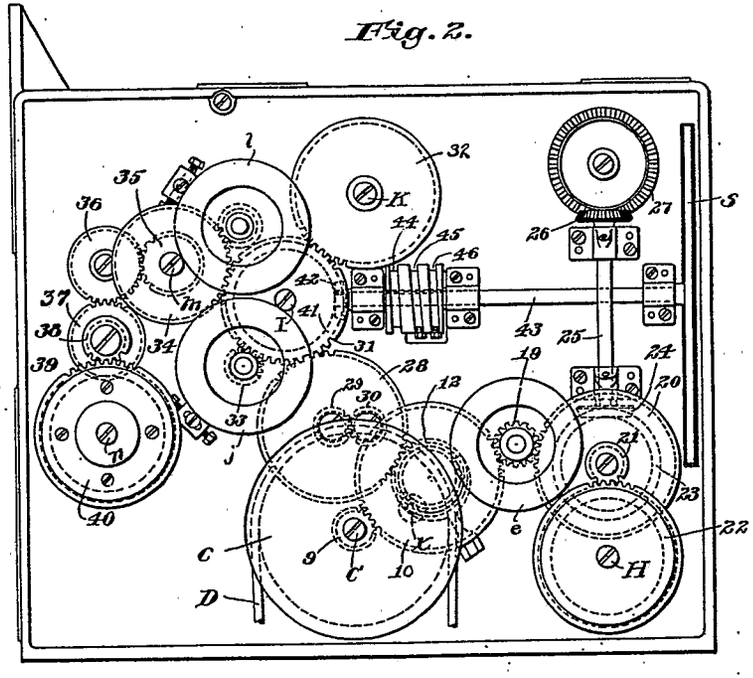

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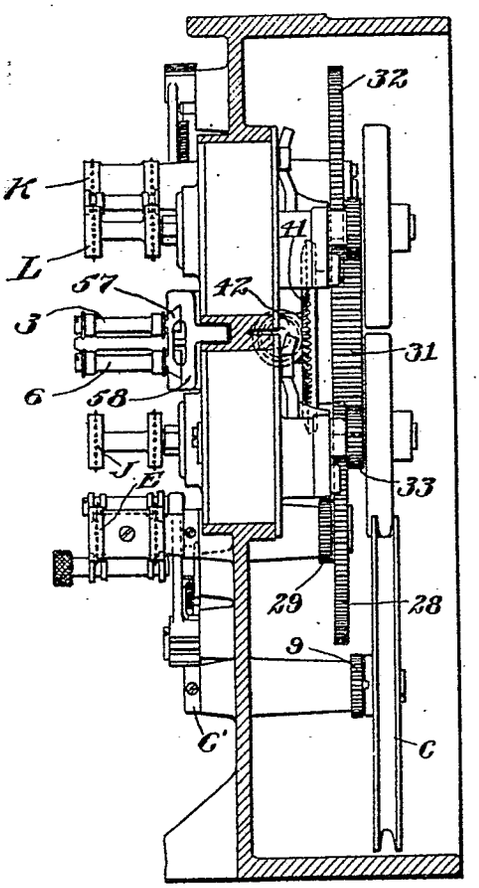
Fig. 3.



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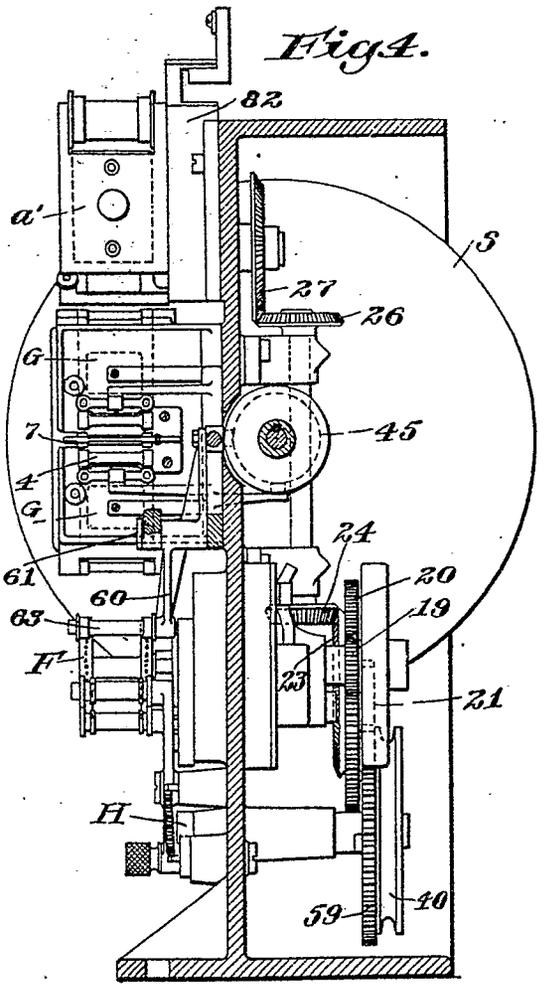
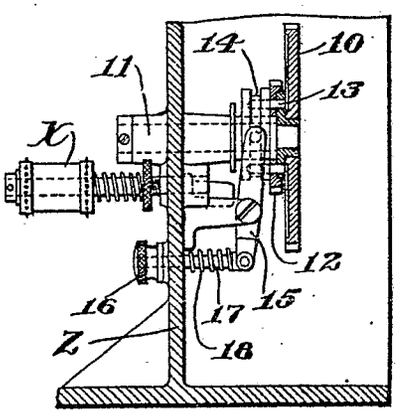


Fig. 5.



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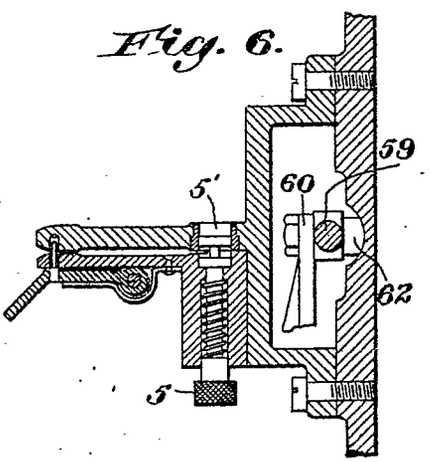

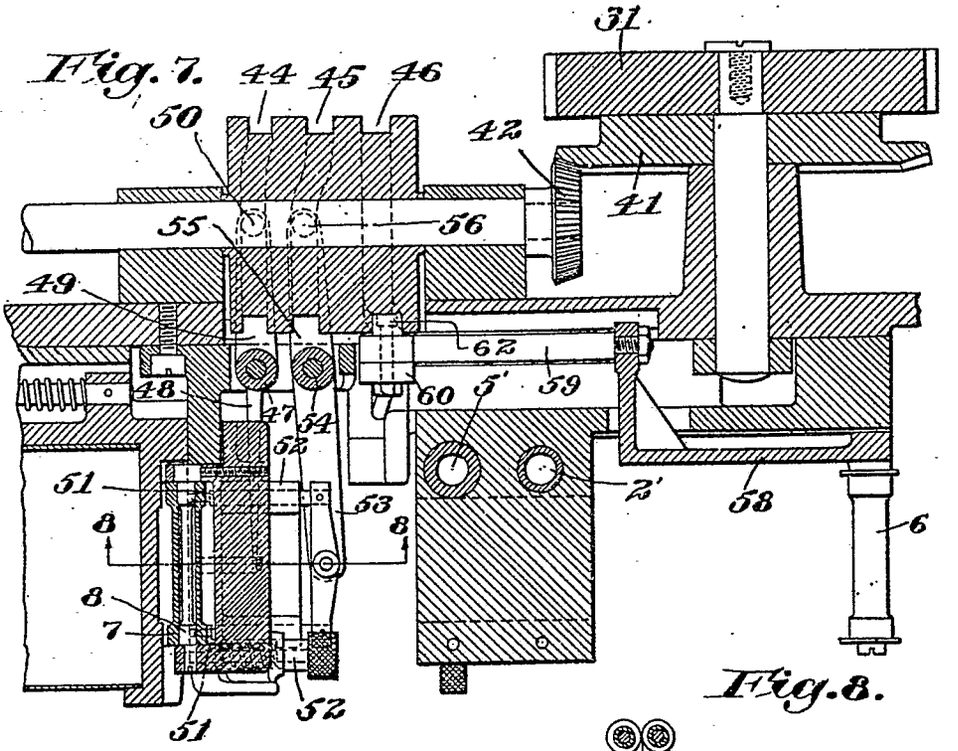
Fig. 7.
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6
51
52

Fig. 8.

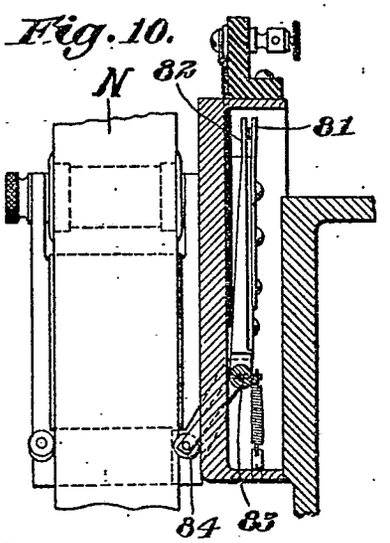
Fig. 10.
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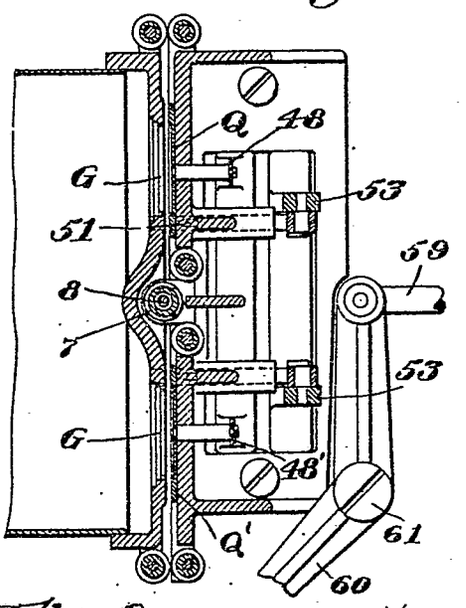
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Fig. 9.

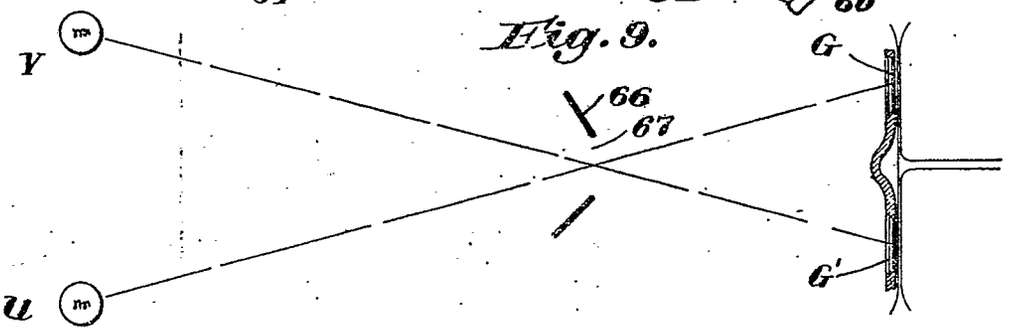
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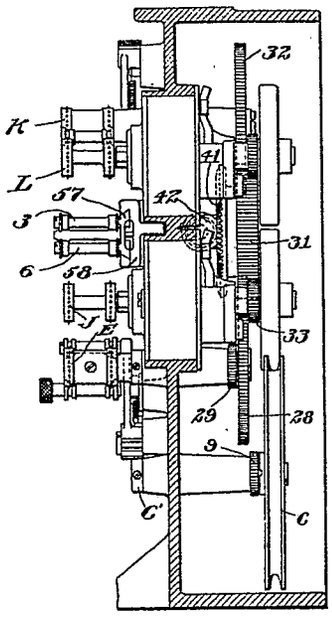
Fig. 3.



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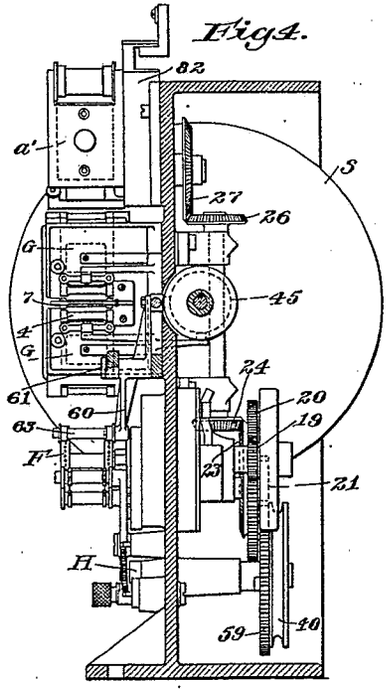

Fig. 5.

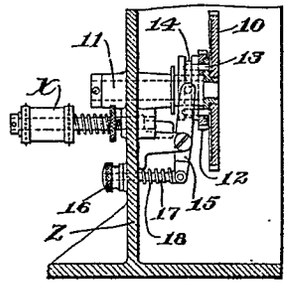

Fig. 6.

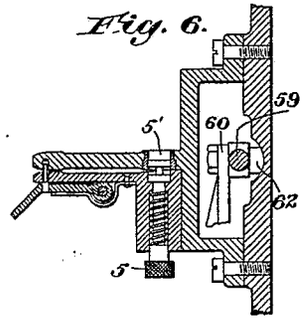

Fig. 7.

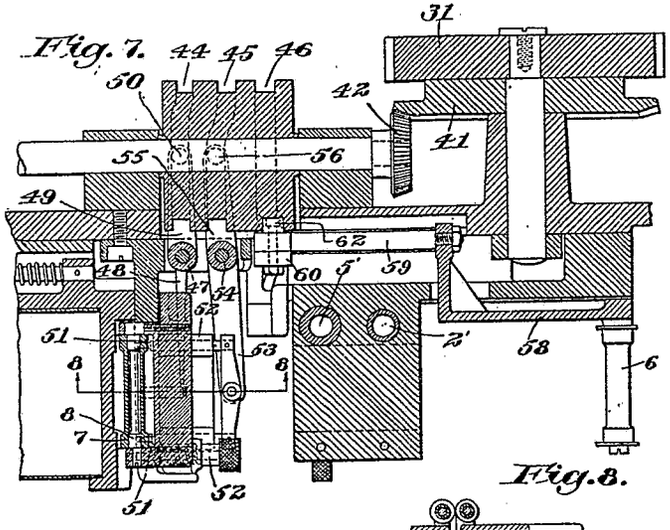

Fig. 8.

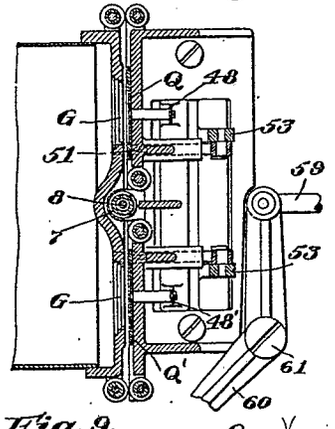

Fig. 10.

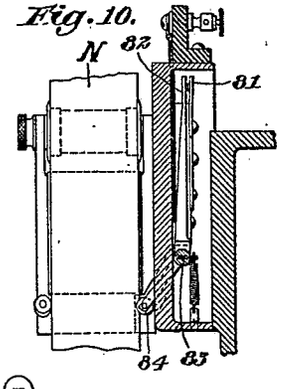

Fig. 9.

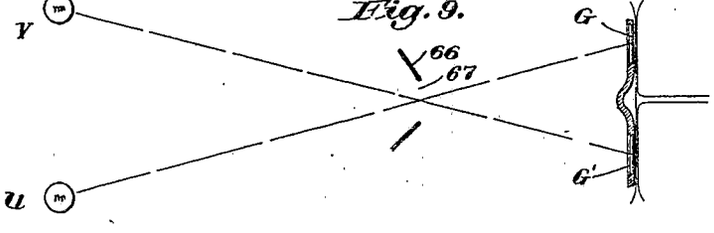

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Fig. 12.

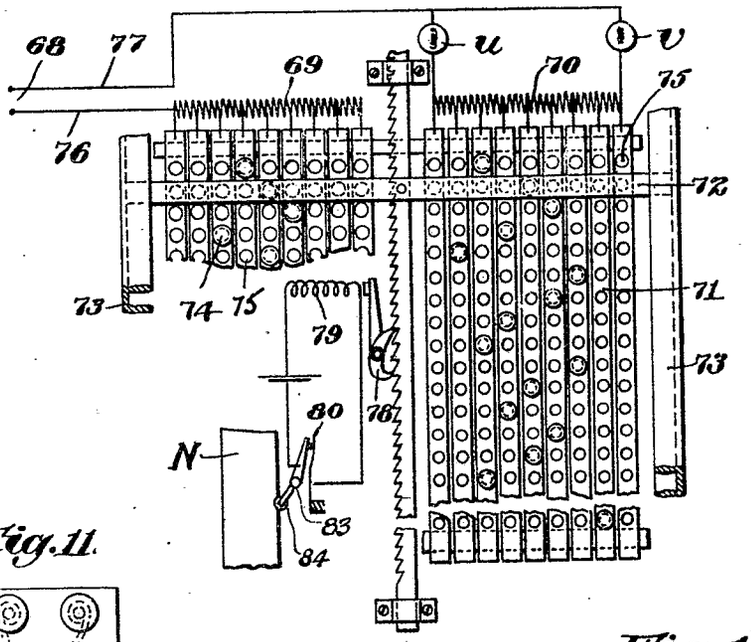


Fig. 11.

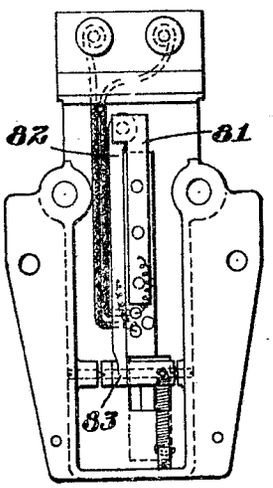


Fig. 13.

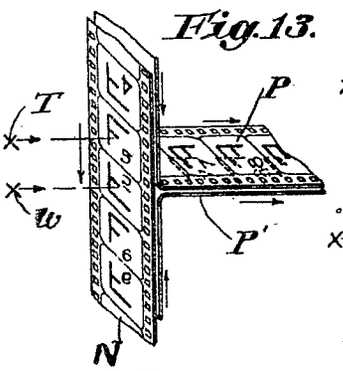


Fig. 14.

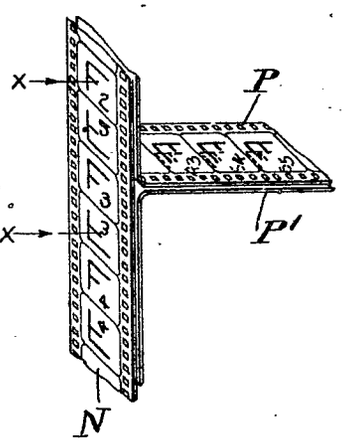
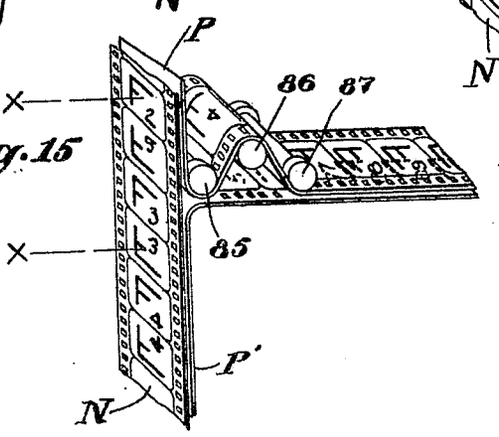


Fig. 15.



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