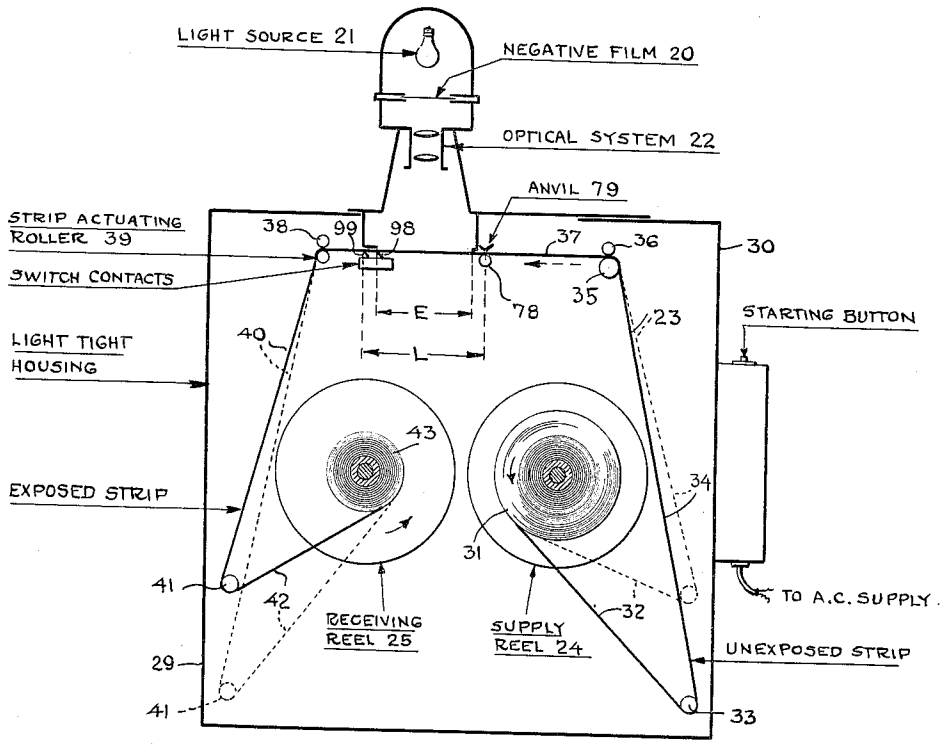
Oct. 5, 1965 A. SIMMON ETAL 3,209,644

PHOTOGRAPHIC ROLL PAPER HOLDER

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FIG. 1.



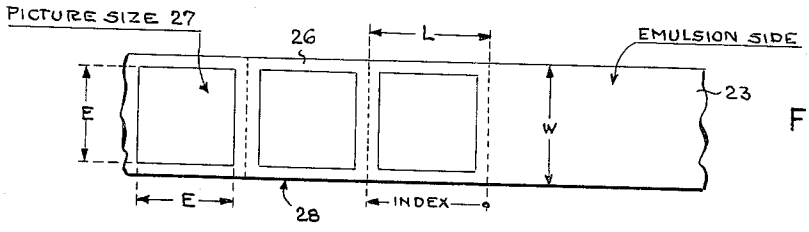


FIG. 2.

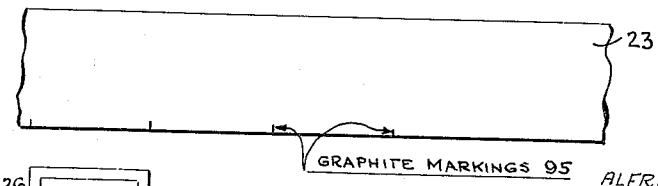


FIG. 3.

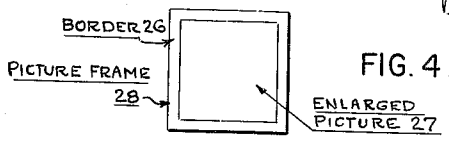


FIG. 4.

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FIG. 5.

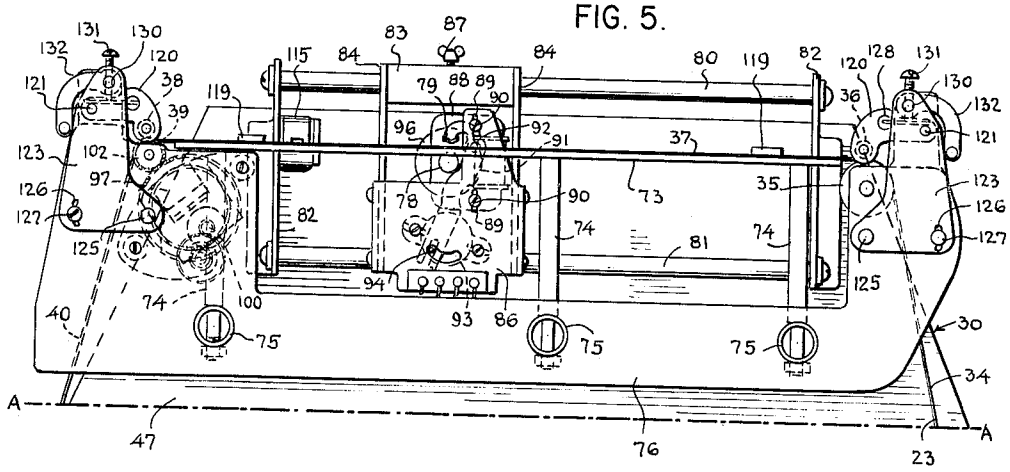
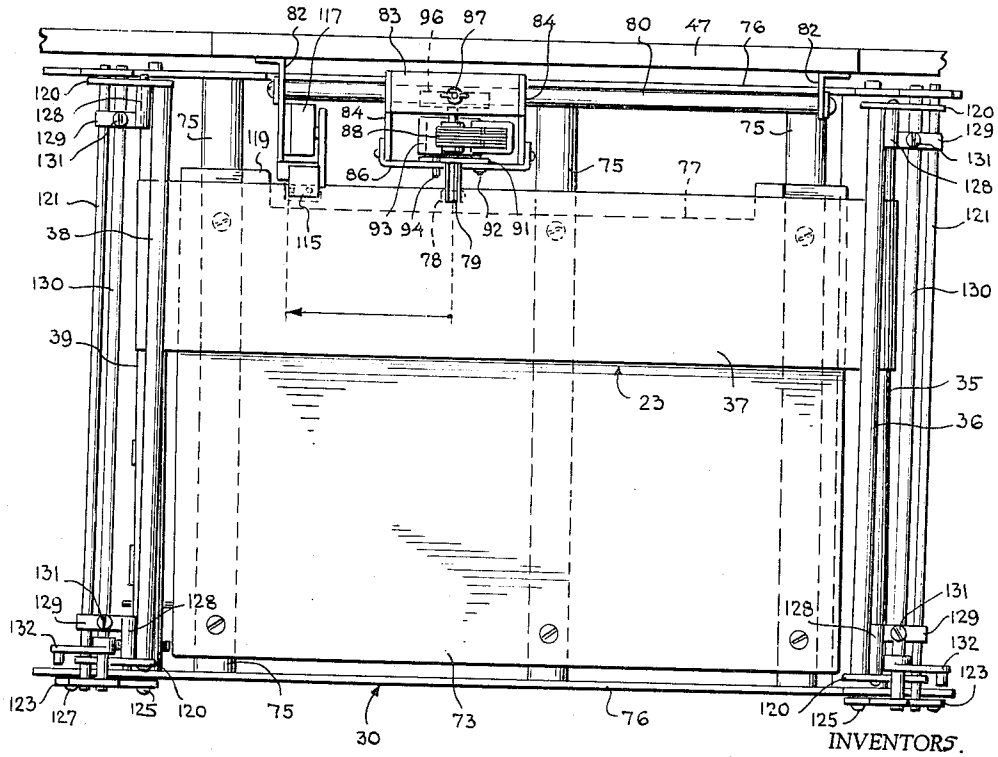


FIG. 6.



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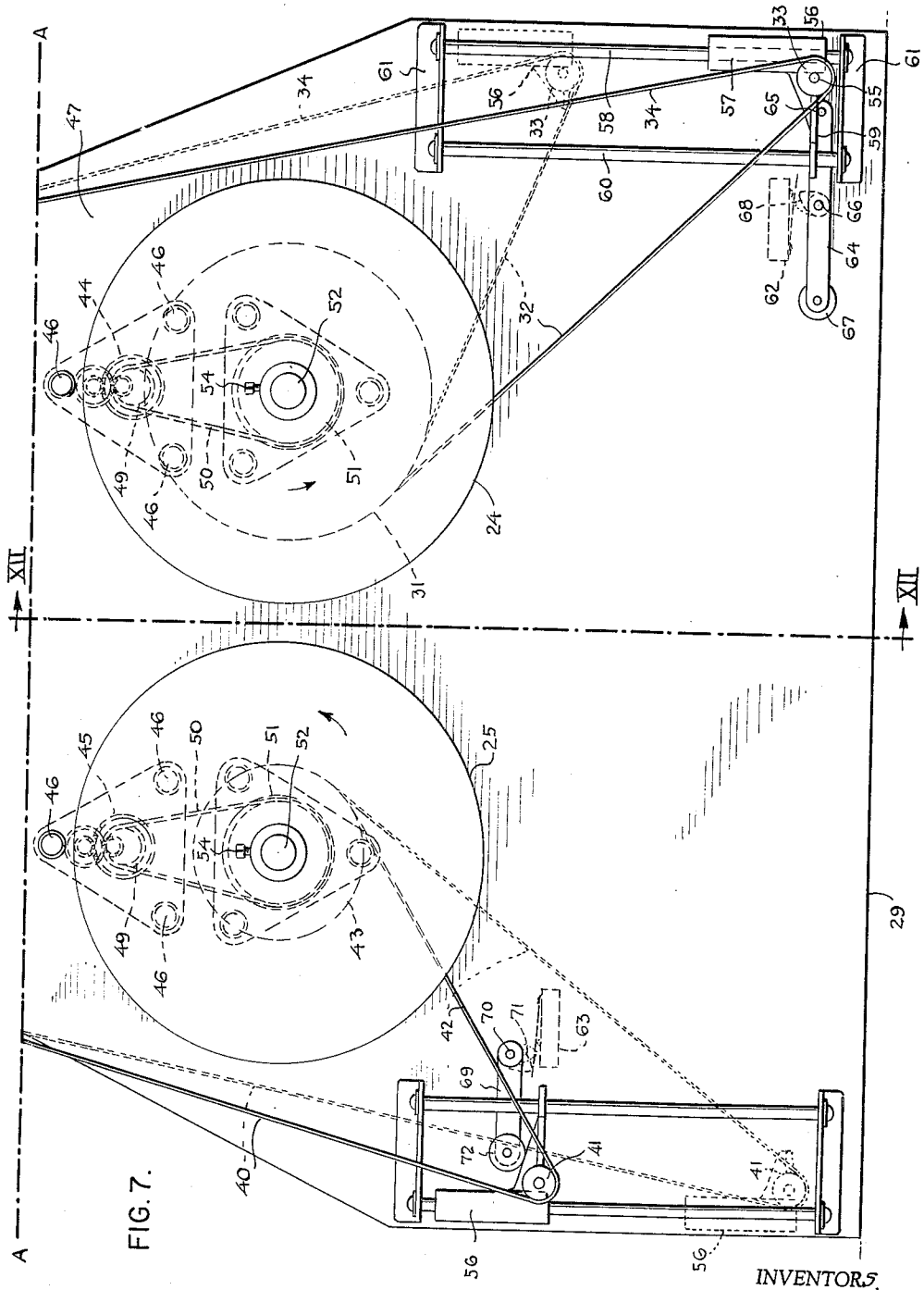


FIG. 7.

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FIG. 8.

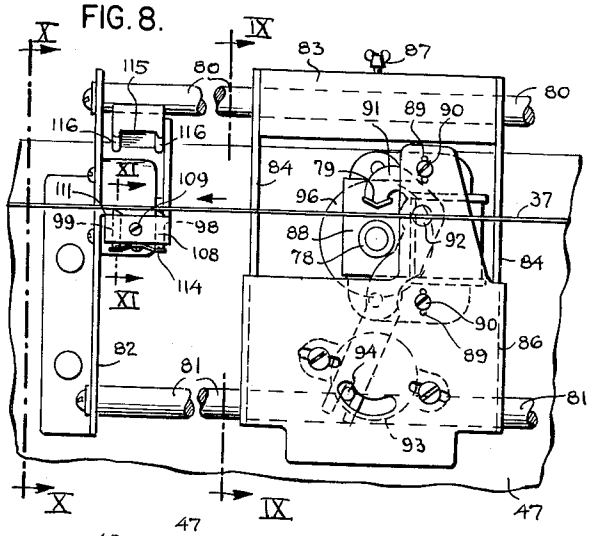


FIG. 9.

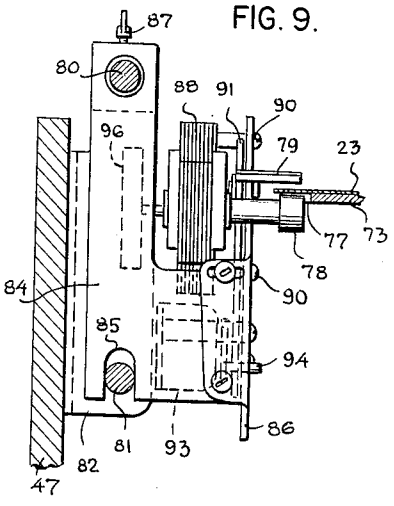


FIG. 12.

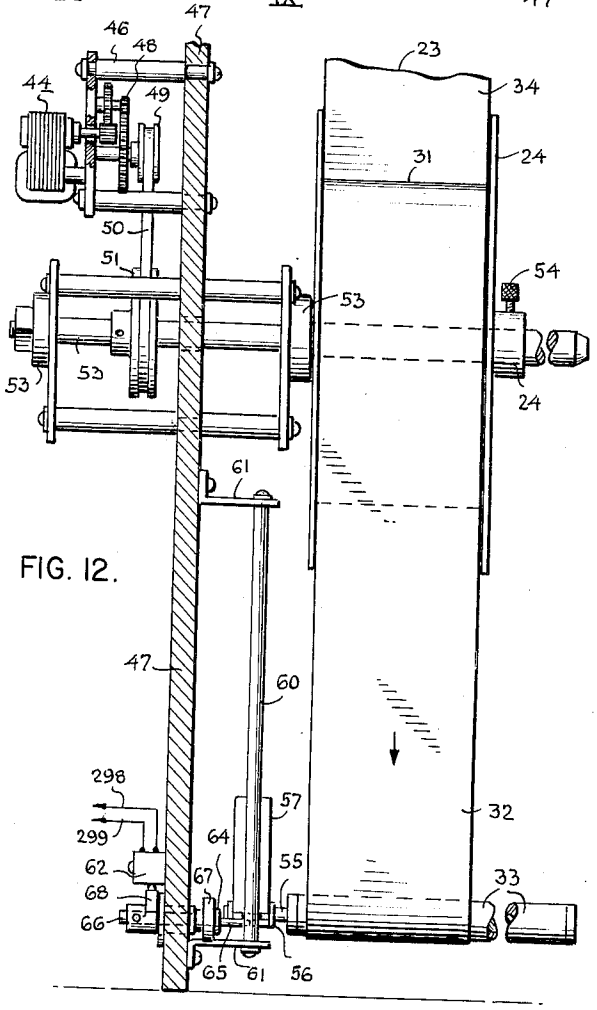


FIG. 10.

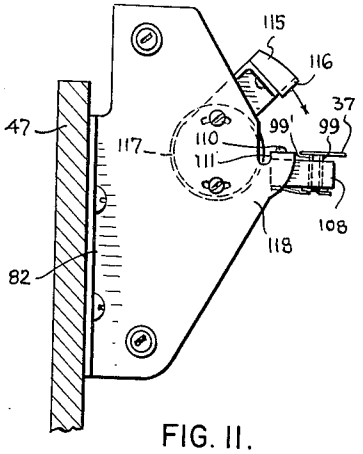
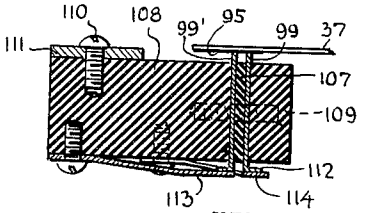


FIG. 11.



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FIG. 13.

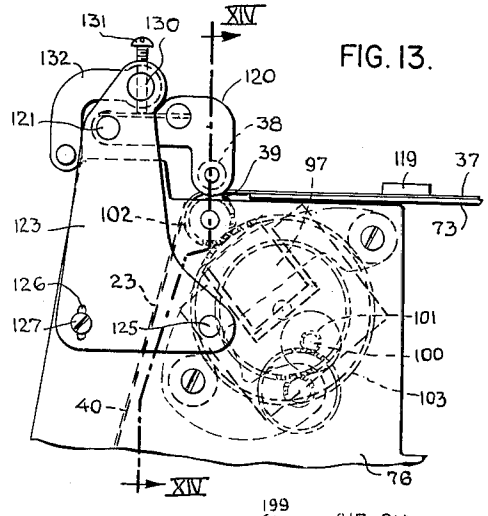


FIG. 14.

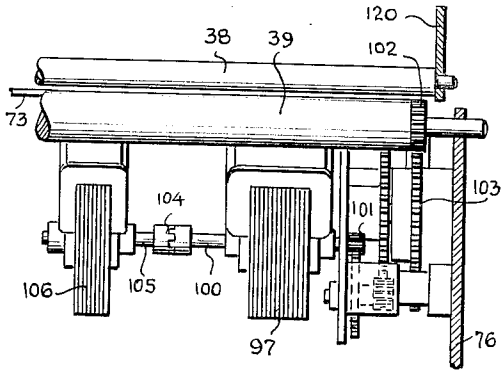
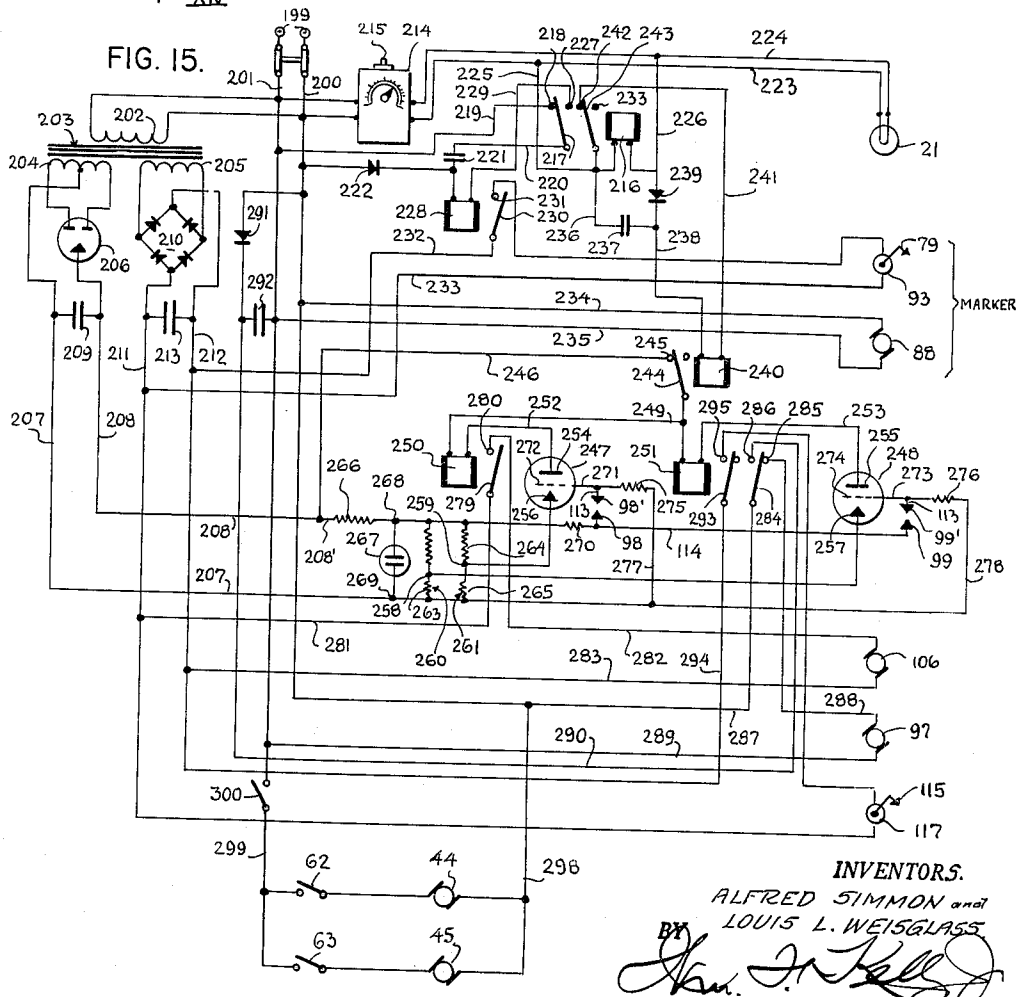


FIG. 15.



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United States Patent Office 3,209,644 Patented Oct. 5, 1965

3,209,644

PHOTOGRAPHIC ROLL PAPER HOLDER

Alfred Simmon, Garden City, and Louis L. Weisglass, New York, N.Y., assignors to Simmon Brothers, Inc., Long Island City, N.Y., a corporation of New York

Filed Apr. 16, 1962, Ser. No. 187,734
5 Claims. (Cl. 88—24)

This invention relates to photo-reproduction apparatus, and more particularly to means and method of making successive exposures on photosensitive strips.

In its general aspect, the invention proposes a means and method by which a photofinisher can make a large number of prints in rapid succession as successive frames on a photo-sensitive strip.

Somewhat more specifically, the invention provides a means and method for obtaining rapid advancement and at the same time an accurate placement of the sensitized strip at its position for exposure.

As it is a prerequisite for the sensitized strip to be stationary during the moments of exposure, the invention contemplates braking means for quickly stopping the strip in its precise position at which exposure is to be made.

The invention also includes means for relieving the section of strip where exposure is being made, from effects of momentum of the rotation of the reels and rolls or from strain of reeling or unreeling the strip.

It is also an included part of the invention to avoid any influence of the varying diameter of the rolls in the spacing between frames reproduced on the strip.

Another object of the invention is to accommodate adjustment for different length of strip both as to frame dimension and as to spacing between the pictures reproduced.

A further attained objective of the invention is to enable the apparatus to accommodate strips of desired width, and to mount the strip so as to be readily introduced and removed.

In greater detail, structure is provided for automatically controlling the reeling and unreeling of the strip by variation in slack developing between the reel and the station of exposure.

Another feature of the invention is to keep the strip in perfect feeding position, without lateral deviation, in approach to and location at the exposure station.

An important feature of the invention is to provide improved marking and measuring means for the successive frames whereby the marking is utilized to obtain both braking action and precise sudden stopping of the strip when advanced the measured distance, by provision of two pairs of contacts successively engaged by the marking applied to the strip.

An essential feature of the invention is to utilize said pairs of contacts and the marking on the strip merely as controls for grid polarities of thyratrons and thereby avoid use of said markings for conveying currents which might be detrimental to said strip.

As a corollary to the foregoing object, provision is made to assure engagement of said marking with said pairs of contacts.

Other objects, advantages and novel features in the structure and method involved with the invention will appear to persons skilled in the art to which it appertains as the description proceeds, both by direct recitation thereof and by implication from the context.

Referring to the accompanying drawings, in which like numerals of reference indicate similar parts throughout the several views;

FIGURE 1 is a view, showing somewhat schematically, the general assembly of elements constituting at least a part of the present invention;

FIGURE 2 is a plan of a portion of the light sensitive face of the photo-sensitive strip, including an indication of several frames having been made successively as occurs in the operation of the apparatus;

FIGURE 3 is an underneath view of said strip showing electrically conductive line-marking as having been applied thereto while the strip progressed in operation;

FIGURE 4 is a plan of a single frame cut from the strip as a final operation in providing, for the customer, an individual picture with precise dimensions of border;

FIGURE 5 is what may be termed a front elevation, without presence of the light-protective housing, of the head portion of the apparatus, which is that portion of the apparatus where the photo-sensitive strip is located when at its reproduction station, and where it is held taut and given a step-by step or indexing motion with intervening stationary periods while being subjected to light exposure;

FIGURE 6 is a plan of said head portion of FIG. 5;

FIGURE 7 is a front elevation of the magazine portion of the apparatus showing the reels and elevator controls therefor, it being noted that the head portion of FIG. 5 is, in the complete apparatus, superposed at bottom line A—A thereof upon top line A—A of the magazine portion of FIG. 7, the two figures taken together being a complete elevation but with outer housing omitted;

FIGURE 8 is an elevation corresponding to a portion of the showing of FIG. 5, but on enlarged scale, so as to better illustrate the line-marking and regulating means for positioning the photo-sensitive strip in its exposure station;

FIGURE 9 is a sectional view on line IX—IX of FIG. 8;

FIGURE 10 is a sectional view on line X—X of FIG. 8;

FIGURE 11 is a sectional view on line XI—XI of FIG. 8;

FIGURE 12 is a sectional view on line XII—XII of FIG. 7;

FIGURE 13 is an elevation of a part of the head portion of the apparatus corresponding to the showing at the left-hand end of FIG. 5, but on increased scale thereover;

FIGURE 14 is an elevational-section taken on line XIV—XIV of FIG. 13; and

FIGURE 15 is a wiring diagram of the circuits and associated elements employed in the apparatus.

In the photographic art, it is a prevalent practice for professional photofinishers to develop films and make prints of the pictures thereof for various customers. It has also become the custom to make such prints with a border peripherally thereof, and to be acceptable, the border must be of even width on all sides of the picture. During the early years of photofinishing, the use of a mat in a print-frame in which the film and sensitized paper were placed produced such a border, but competition of the present day requires more speedy operation, and in most cases requires enlargement of the picture from the size of the film or other negative.

The present invention provides an apparatus wherein a film **20**, here referred to as the negative, of which a reproduction is desired, is inserted between a source of light **21** and a lens system **22** beyond which, at its station of exposure, is located the photo-sensitive area, usually sensitized paper, and herein constituted as part of a strip **23** capable of being unrolled from a supply reel **24** and rerolled on a receiving reel **25**, and therebetween passing through said station of exposure under said lens system. The individual pictures are utilmately cut apart from said strip. The exposed area of the strip for any single picture is such that an unexposed border **26** is provided peripherally of the picture area **27**, as shown in FIG. 4, ex-

tending for length L in FIG. 1, and in the following description, the picture area with its border will be referred to as frame 28. It is an essential feature of the present invention to advance the strip with a measured length of step-by-step motion and with such precision that the frames can be ultimately severed one from another and leave a border at both sides of the cut which will be the exact desired width wtihout further trimming.

It will be readily appreciated, in winding a strip onto a roll, that as the roll increases in diameter, a pre-established angular degree of rotation will result in an ever increasing length of strip being drawn onto the roll, and consequently it is not practical to govern the length of frame by the pull and rotation of a receiving roll. Furthermore, as the roll enlarges and becomes heavier, its inertia and momentum likewise increase and consequently become further deterring factors in trying to utilize rotation of the roll in advancing the strip to its station of exposure with any definite degree of accuracy.

More specifically, the invention may be considered as providing a magazine section 29 wherein the unreeling of the strip 23 from supply reel 24, and rewinding in a roll on the receiving reel 25 is effected and controlled. In accordance with the invention, the reeling and unreeling is effected without exerting undue pull or tension on the section of the strip located at the station of exposure under the lens system, and without encumbering that section with any effects of inertia of the rolls and reels. An even tension and advancement of the last-mentioned section of the strip is effected in what is herein termed the head portion 30 of the apparatus. Said head portion also provides measuring means governing the exact length of frame for positioning during the pause of the step-by-step motion at the station of exposure, and more fully described hereinafter.

An understanding of this feature of the invention can be gained by first considering the course taken by the sensitized strip 23 and operational influences applied thereto. Referring initially to FIG. 1, the strip 23 upon leaving its supply roll 31 in supply reel 24 located in magazine section 29, is fed as a downwardly traveling reach 32 to and under a transitionally mounted roller 33 which, in addition to being rotatable, tends to gravitate downwardly, and for identification purposes will be referred to as a gravitational roller. From said gravitational roller 33 the strip then extends as an upwardly directed reach 34 at the outer side of said roller at such angle as to pass by the supply roll 31. Said reaches 32 and 34 form a loop with said gravitating roller 33 in the bottom smaller end and with said reaches diverging upwardly. Motion of the strip in the downwardly extending reach 32 being in a downward direction, it will be obvious that movement of the strip in the other or upwardly extending reach 34 will be in an upward direction.

Said upwardly extending reach 34 introduces the strip 23 into the head portion 30 of the apparatus, where it passes over a guide roller 35 and under an associated pressure roller 36 to proceed therefrom as a horizontal reach 37 at a location and for a distance above both the supply reel 24 and the receiving reel 25. It is a part of this horizontal reach 37 of the strip 23 that exposure is made on area E thereof by the light 21 acting through the negative 20 and lens system 22 above mentioned, and it is this area that constitutes the exposure station.

Beyond the exposure station, the horizontal reach 37 passes between an associated pair of rollers of which the upper one is a pressure roller 38 and the under one is an actuating roller 39. The strip 23 bends downwardly over the actuating roller 39 to a downward reach 40 and moving downwardly is thereby introduced again into the magazine section 29, clearing receiving reel 25 and making a partial turn around a second gravitational roller 41 located at a level below the receiving reel so that the strip will again form a loop by a companion upwardly diverging reach 42, to wind up as a receiving roll 43 on receiving reel 25 with the last mentioned gravitational roller 41 in the bottom smaller end of that loop.

As indicated in FIGS. 7 and 15, the supply reel 24 has a driving motor 44 and the receiving reel 25 has a driving motor 45 arranged to respectively turn the reels to unwind the strip from the supply roll 31 and to rewind it on the receiving roll 43. By reference to FIG. 12, it will be seen that driving motor 44 is mounted by legs 46 on the outside of the apparatus casing wall 47 and has associated therewith a train of reduction gears 48 connected with and rotating a drive pulley 49 which in turn, by an interconnecting belt 50, rotates a driven pulley 51 fixed on a shaft 52. Said shaft has bearings 53 rigidly mounted at a distance from and on opposite sides of the pulley and casing wall, enabling said shaft to be of cantilever type so that its inner end which projects a considerable distance within the casing will be free to receive supply reel 24 thereon, a feature conducive to readily loading the apparatus with fresh rolls of sensitized strips. A thumb screw 54 is shown for fixing the reel on the shaft to rotate in unison therewith. As the driving motor 45 for the receiving reel, and associated gears, shaft and pulleys are in duplication of those just described for the supply reel, indication of which is evident in FIG. 7, further illustration and description will not be indulged in as it is deemed unnecessary to an understanding thereof.

Automatic means are provided to cause said reel motors 44, 45 to operate as needed and to discontinue operating under predetermined circumstances of slack condition of the respective loops of the strip 23 and location of gravitational rollers 33 and 41. Again referring to FIGS. 7 and 12, the gravitational roller 33 for the supply loop of strip 23 is also conveniently of cantilever type so as to readily admit introduction of the strip at the free end of the roller in loading the strip in the apparatus. The said gravitational roller 33 is rotatable upon an axle 55 which is secured rigidly to an elevator 56. Said elevator provides a vertically disposed glider sleeve 57 which is free to slide on an upright track or rod 58, and provides a horizontally disposed basal portion 59 projecting laterally from said glider sleeve and forked at its end remote from said sleeve to ride upon another track or rod 60 parallel to and coextensive with the first mentioned rod 58. Engagement of the forked end of said elevator body with the second said rod prevents the elevator from rotating but admits unrestrained vertical movement of said elevator. Said rods or tracks 58, 60 are fixed at their upper and lower ends in brackets 61 secured to the casing wall 47. As so far described, as will be evident from inspection of FIG. 7, the gravitational roller 41 for the loop leading to the receiving roll 43 is similarly mounted, and corresponding parts are accordingly identified by the same reference numerals. There is a difference, however, in operational effect, namely, that gravitational roller 33 in the loop proximate to the supply roll 31 causes an electric switch 62 to open when that roller is at its lowermost position, whereas the other gravitational roller 41 in the loop proximate to receiving roll 43 causes an electric switch 63 to open when that roller is at its uppermost position, as will presently be referred to more fully.

It will be remembered that the supply reel 24 is provided with a motor 44 which, when driven, unrolls strip 23 from supply roll 31, and thereby tends to produce slack in the loop proximate to said supply roll. As a result of such slack the gravitational roller 33 situated in that loop loses height in its support from the loop and gravitates downwardly by virtue of its own weight and weight of vertically slidable elevator 56 on which it is mounted.

Proximate to the lowermost position attainable by said elevator 56 there is a lever 64 next to one end of which is a pin 65 projecting laterally therefrom into a position underlying the downward path of movement of the elevator. Intermediate the ends of said lever 64 the same is fixed on a rotatable stud shaft 66 supplying pivotal mounting for said lever. At the other or far end of the lever

from said pin, a weight **67** is supplied thereon so that the lever will normally swing to a position lifting said pin **65** ready to be depressed when the elevator moves downwardly in engagement therewith. Said stud shaft **66** projects through casing wall **47** and at the outside of said wall carries a cam **68** which is oscillated by the shaft in consequence of swinging motion of the lever. In the normal position of the lever, said cam engages aforementioned electric switch **62** to maintain a closed electric circuit to the supply reel motor **44**, but when the elevator **56** depresses pin **65**, the lever and cam are swung and the cam permits the said switch to open so the motor will stop and further slack in the strip loop is temporarily discontinued.

At the other side of magazine section **29**, electric switch **63**, which is normally closed, is located proximate to the upper end of the stroke of elevator **56** on which gravitational roller **41** is mounted. In this instance, a lever **69** is provided to be swung from its normal position by lifting engagement of the elevator therewith. It will be observed that the elevator is raised to its uppermost position by contraction of the loop of strip **23** having its slack reduced due to the strip winding up on its receiving roll **43** faster than the strip is supplied to the loop from the associated pressure and actuating rollers **38, 39** at the end of the horizontal reach **37**.

This said lever **69** is fixed upon a rotatable stud **70** which in this instance is proximate to an end of the lever and projects rotatably through the casing wall **47**. The outwardly projecting end of said stud **70** has a cam **71** fixed thereon and directed downwardly toward aforementioned switch **63** and due to the weight of the lever, said cam normally engages said switch to maintain the switch losed and the motor **25** in operation. However, when the slack is so far reduced as to bring the gravitational roller **41** and its elevator to uppermost position, engagement of the elevator with the lever **69** then takes place and the switch opened. In this connection it may be mentioned that the end of the lever which projects into the path of movement of the elevator is equipped with antifriction means, such as wheel **72** for engagement with the elevator. This wheel adds to the weight of that end of the lever to help maintain its normally downward position until lifted by the elevator. Also, it may be said, that since the switch **63** is in series with motor **45** for the receiving reel, opening of said switch at the upper end of the stroke of the elevator, stops the motor and further winding of the strip ceases until more slack is provided in the loop of the strip enabling the roller **41** and its associated elevator **56** to gravitate downwardly and again cause the switch to close.

Since it has been indicated previously herein that the horizontal reach **37** of the strip is advanced by the associated rollers **38, 39** at the end of that reach, it will now be apparent that there is no obligation imposed upon the strip and those rollers to either apply actuating force to the supply roll **31** or retarding force on the receiving roll **43**. The weight of the gravitational rollers and their elevators suffices to keep the strip taut at the horizontal reach without imposing strains of forces to cope with inertia of either the supply roll or the receiving roll which otherwise would occur without presence of the slack and control means described above.

Accurate advancement with a step-by-step motion of the horizontal reach **37** of the strip is essential, and includes means for measuring and designating the distance for advancement for each step of motion of the strip, and means for applying braking effect on advancement of the strip as it approaches the designated distance, and means to stop the advancement precisely at the designated distance. It may be stated as a fact, which will be substantiated shortly, that the horizontal reach **37** of the strip intermittently stands still, that being a necessary circumstance in order that it may have the picture from the negative transmitted thereto for reproduction on the

sensitized upper surface of the strip without blurring. Following the slowing down of the horizontal reach **37** of the strip by the braking action, said strip is brought to a sudden stop at the precise measured distance. It is while the strip is in this state of quietude that the picture is transmitted to the upper sensitized face thereof and at the same time designation is made on the under face of the strip of a measured distance for its next step forward.

Furthermore, it may be pointed out at this time, that the horizontal reach **37** of the strip is supported throughout its length on a rigid platen **73** the top surface of which is in a plane tangential to the rollers **35** and **39** over which said strip approaches to and departs from its horizontal reach. This platen **73** is shown in FIGS. 5 and 6 attached to and resting upon the upper ends of posts **74** the lower ends of which are attached to and carried by cross members, here shown as tubes **75** paralleling said rollers, said cross members in turn being secured at their ends to side panels **76** of head section **30**. At what may be termed, for orienting purposes, the back of said plate, a cut-out **77** is provided therein by virtue of which a longitudinal margin of a part of the horizontal reach **37** of the strip overlaps the cut-out, and it is at this overlapping part of the strip that the aforementioned designation of measured length is applied to the under face of said strip.

The means for imposing such designation of measured distance comprises, in the present specific disclosure, a marker **78** adjustably located in said cut-out at the under face of said overlapping margin of the strip, and a depressible anvil **79** thereabove to exert striking pressure at the proper time and place upon the top of the strip so as to create a marking on the under side of the strip. Except when the mark is being applied to the strip by a striking blow of the anvil, both the marker and anvil are out of contact from said strip, a small clearance being sufficient for the marker to keep it from smearing said strip.

Considering the specific showing of this marking mechanism more in detail, FIGS. 5, 6, 8 and 9 in particular show a pair of horizontally disposed rails **80, 81** the axes whereof lie in a vertical plane proximate to the back wall **47** of the casing, and mounted thereon in fixed position by brackets **82**. Slidable on the upper one, **80**, of said rails is a sleeve **83**. Fixed to and depending from the ends of said sleeve are parallel end plates **84** which are provided with bottom notches **85** to ride upon the bottom one, **81**, of said rails. At the front edges of said end plates **84** there is a front plate **86** appropriately secured to said end plates so that said front plate, end plates and sleeve constitute a rigid carriage which may be moved horizontally to desired position along said rails and retained in such position to which adjusted for the particular size of frame to be formed on the sensitized strip. In order not to complicate the drawings, a set-screw **87** is shown intermediate of the ends of the sleeve adapted to obtain fixation of the said carriage in adjusted position. It is, however, within the scope of the invention to employ a worm parallel to the rails, said worm making threaded engagement with one of the end plates for both moving and holding the carriage in adjusted position, in a manner corresponding to the showing of such a worm in U.S. Patent 1,926,392 of Sept. 12, 1933, to Charles C. Kritzer, entitled "Mounting."

On the back of said front plate **86** of the carriage is mounted a motor **88** the shaft of which projects forwardly through said front plate and has fixed thereon a marking element **78**, such as a wheel formed of graphite or other scribing material of electrical conductive characteristic. As may be seen in FIG. 9, this marking wheel lies immediately below the margin of the strip **23**, and may be adjusted to proper closeness thereto by adjusting the entire motor up or down on said front plate by virtue of slots **89** in said plate receiving the mounting screws **90** of the motor.

The anvil 79 is carried on a short end of a lever 91 fulcrumed by pivot 92 at the back side of said front plate 86, but wtih the anvil 79 protruding forwardly past the plate so as to overlie marking wheel 78. The longer arm of said lever 91 extends downwardly toward and near to the bottom of said front plate, and is shown terminating with a forked end. Back of the forked end of said lever there is a rotary solenoid 93, by which is meant a solenoid that, when energized, causes its armature to rotate through a certain angle. A pin 94 projecting eccentrically from the solenoid armature rides in said forked end of lever 91 and when the solenoid is energized said pin has an oscillating motion and thereby swings the lever. The solenoid 93 has slot and screw mounting upon front plate 86 which enables the solenoid to be adjusted in proper position to apply the desired striking movement and force to anvil 79. In view of the differential in length of the arms of lever 91, the movement of anvil 79 is less distance than movement of the solenoid pin 94, but the striking force is increased. Activation of the solenoid is timed to cause the anvil to strike strip 23 while the strip is at rest, and since the marker 78 is rotating, a deposit of the graphite or other marking material will be applied as a short single line mark 95 on the under surface of the margin of the strip in exact correspondence to the under edge of the anvil. To avoid stopping the motor 88 due to friction introduced by the striking engagement of the anvil with the stationary strip, a fly-wheel 96 may be mounted on the rear end of the motor shaft.

It will be understood from the foregoing description, that forward travel of the horizontal reach 37 of strip 23 is obtained by rotation of actuating roller 39 at the forward end of said horizontal reach, and that there is a motor 97 which applies the rotational actuation of said roller 39. While inherently the type of this motor 97 may be chosen as desired by the manufacturer, it is preferred to use a so-called shaded pole motor because it is readily available on the market and is inexpensive.

As the horizontal reach 37 of strip 23 approaches position at which it is to be stopped, the actuating motor 97 is first slowed down and then stopped at the precise position of the measured length, use being made of the electrical conductivity of line marking 95 that was previously made at the last stationary situation of the strip. For this purpose, two pairs of triggering contacts 98, 98′ and 99, 99′ are provided under the margin of the strip, and as the line marking 95 arrives at the first pair 98, 98′, a triggering circuit is completed by the conductive marking through the contacts of that pair, the effect of which, as hereafter explained, slows actuating motor 97. Promptly thereafter, the conductive marking arrives in bridging engagement with the second pair of triggering contacts 99, 99′ and completes a triggering circuit which stops the motor immediately, and the strip stands still. While thus standing still, the strip again receives the next marking from the graphite marker element 78, and the distance from the first mark to the second is the precise desired measured length L in FIG. 1 for the frame 28. By properly setting the carriage with its marking apparatus on its rails 80, 81, successive pictures can be made on strip 23 with the exact distance therebetween to give a proper width of border when the strip is severed subsequently midway between the pictures. If larger pictures are to be made, the carriage is adjusted further to the right and a roll of wider strip substituted for the narrow one shown. It will also be noted that the supporting platen 73 for the horizontal reach 37 of the strip, and the several rollers in engagement with the strip, are wide enough to accommodate strips of considerable width and much wider than the particular strip illustrated. In any event, however, the line marking 95 always occurs at the margin of said strip no matter what width of strip is employed.

Actuating motor 97 for the actuating roller 39 is located at least in part beneath said roller as may be seen in FIG. 14, but to avoid confusion, has been omitted from appearing in FIG. 6. As clearly evident in FIG. 14, the armature shaft 100 of said motor has a pinion 101 thereon, and actuating roller 39 also is equipped with a pinion 102 driven by a train of gears 103 for producing the desired rapidity of forward movement of the horizontal reach 37 of the strip. Aligned with and coupled at 104 to armature shaft 100 of motor 97 at the opposite end from said pinion 101 is an armature shaft 105 of a shaded-pole motor 106, the field of which is energized, as will subsequently appear in considering the electric circuits involved, by direct current rather than alternating current, so as to function as a brake. Control of the circuit to this brake motor 106 is effected through the conductive line marking 95 on the under side of the strip coming to and engaging the first pair of contacts 98, 98′, and forthwith speed of the actuating motor 97 is retarded and in consequence the forward movement of the horizontal reach 37 is slowed down to such an extent that when said line marking 95 reaches and completes the circuit between the second pair of contacts 99, 99′ the actuating motor will be stopped as will become apparent by subsequent explanation of the electrical circuits involved.

Attention may be given at this point to the physical construction here shown for said triggering contacts 98, 98′, and 99, 99′ with reference to the showing thereof in FIGS. 8 and 11. As the first pair of contacts 98, 98′ are spaced from but behind the second pair 99, 99′ in sectional view of FIG. 11, but are identical therewith as will be apparent from FIG. 8, specific description of the one pair is deemed sufficient for a full understanding. Said contacts are made of adequately rigid flat metal positioned upright with the flat sides toward and parallel to each other but with the two said contacts of the pair held apart by an intervening layer 107 of insulation. The major portion of the upright lengths of said contacts, together with said intervening layer 107 of insulation, are mounted in an insulating block 108 which, for convenience of manufacture and assembly may be of two-piece construction held together by a screw 109. Said block is conveniently carried in fixed position by attachment with a screw 110 to a horizontally bent tab 111 formed from the rail-supporting bracket 82. It will be noted that the planes of said contacts are transverse to line marking 95 of the strip and arranged so that said line marking comes into juxtaposition to the two contacts of the pair simultaneously. The upper ends of said contacts protrude above said block 108 toward said strip margin, and preferably slope upwardly in direction of movement of the strip so that the line marking on the strip will engage the said contacts at the peaks of said slopes and thereby very accurately trigger the electric circuit. The lower ends of the triggering contacts project below said block 108 and are bent thereunder away from each other to provide feet 112 which will limit upward displacement of the said triggering contacts. One contact, as 98′ and 99′ or each pair of said contacts has an individual leaf-spring 113 at the under side of the block bearing against the under end and foot of the respective contact, whereas a single leaf-spring 114 common to the other ones, 98 and 99, of the contacts of the two pairs engages under the feet 112 of both thereof. The common spring 114 functions as an electric in-lead to the two contacts engaged thereby, whereas the other two contacts 98′ and 99′ has an individual in-lead constituted by the individual spring 113 thereto.

In order to assure good electrical contact of the line marking 95 with the peaks of the sloping upper ends of said triggering contacts, a swinging depresser 115 is provided and adapted to be brought down upon the upper surface of the strip directly above all of said contacts 98, 98′, 99 and 99′. Preferably said depresser is made of nylon or the like, and the under face provides ribs 116 which will register with the ends of the said contacts, the strip of course intervening, when said depresser is swung to its downward position. Such downward swinging of

the depresser is performed when the line-marking is directly over said contacts, and firm engagement of said line-marking with said contacts is thereby assured. The depresser **115** is under operational control of a rotational solenoid **117** adjustably mounted by slot and screw attachment to a bracket **118** so as to apply desired pressure upon the strip at the proper time interval. Current to the depresser solenoid **117** is supplied during conductive period of a thyratron **248** identified subsequently in describing the electrical circuits involved. It may be added here, however, that current to said solenoid **117** is applied simultaneously with discontinuance of current to the strip actuating motor **97**, said current to the solenoid continuing until the picture exposure is completed at which time the circuit to the solenoid is interrupted and the swinging depresser **115** returns to its lifted position illustrated in FIG. 10.

It is important, not only to assure proper width of border **26** at longitudinal opposite edges of strip **23**, but to also assure that the margin with the line marking **95** thereunder shall track correctly, that the strip be kept in a straight path as it advances along the horizontal reach **37**. For accomplishment of this purpose, as best shown in FIGS. 5 and 6, said pressure rollers **36** and **38** are not precisely parallel to the rollers **35** and **39** respectively thereunder with which they cooperate, but are slightly askew, the amount being somewhat exaggerated in the drawing so as to make the fact of non-paralleism more apparent. The skew angle, or angle of obliquity, of said pressure rolls is in such direction as to create a tendency in the strip to shift toward the rear of the horizontal platen **73** on which it is sliding. At the back edge of said platen, projecting upwardly therefrom so as to be engaged by the rear edge of the strip, are guide lugs **119** which are preferably of nylon or other suitable material of low frictional resistance to the strip and non-injurious to said strip. The strip will be caused, therefore, to ride at its rear edge against said guide lugs and as a consequence will be maintained in a straight path constantly.

According to the present showing, mounting and disposition of the pressure rollers **36** and **38** are alike for both of said rollers, so a single desription will suffice. At each end of each pressure roller, the same is trunnioned in one end portion of an arm **120** the other end of which is pivotally carried by a rod **121** parallel to the roller, thus permitting the arms and presure roller to be pressed downwardly to keep said roller in contact with the strip. The end of the pivot rod **121** toward the back of the apparatus is engaged in a hole of equal size thereto in the rear panel member **76** of head portion **30** of the apparatus, and therefore is relatively fixed. The other end of the said pivot rod **121** toward the front of the apparatus is engaged in a hole of equal size thereto in a bracket **123**, here shown as a flat plate, located flatwise of and at the front of the front panel member **76** of head portion **30**. This bracket **123** is pivoted, as at **125**, near a bottom corner thereof, and at a distance from the pivot has a slot **126** receiving a screw **127** therethrough for clamping said bracket in adjusted position to obtain proper skewed engagement of the pressure roller with the strip. Spring pressure is also provided for the pressure roller, for which purpose each arm **120** intermediate of the pressure roller and pivoting of the arm on rod **121**, has a lateral spur **128** projecting therefrom parallel to said roller and carrying one end of a leaf-spring **129** the other end of which crosses over said pivot rod **121**. Above the springs, extending from and mounted in the rear panel member **122**, to said bracket **123** at the front panel member **124**, is a rotatable rod **130**. Pressure screws **131** extend downwardly through this rotatable rod **130** and make engagement with and medially of the lengths of said leaf-springs **129**. When desired, as for instance when inserting a new strip **23** between the rollers, said rotatable rod **130** may be turned, thereby removing the engagement of the pressure screws from said leaf-springs. A crank arm **132** is fixed on said rotatable rod to make rotation thereof more convenient and cooperating with said screws to produce a toggle action for retaining the screws in compressing engagement against the springs while the apparatus is in operation.

Considering now the electrical circuits involved in connection with the above-described apparatus and method, attention will be given primarily to FIG. 15 wherein use is made of current from a usual commercial A.C. source of electricity rated at about 115 volts and 60 cycles, and designated in the drawing by numeral **199** and feeding main circuit wires or bus bars **200, 201** in the apparatus. Current derived from said bus bars feeds the primary coil **202** of a transformer **203**, which has two secondaries **204** and **205**. One of these secondaries, as **204**, feeds a full-wave tube rectifier **206** from which is obtained a high D.C. voltage (approximately 280 volts) feeding to a first pair of auxiliary negative and positive bus bars **207, 208** respectively, between which is provided a capacitor **209**. Use for this high voltage output will appear later herein. The other said secondary **205** of transformer **203** is shown feeding a Wheatstone bridge type of rectifier **210** the output of which is low D.C. voltage (approximately 22 volts) which is fed to a second pair of auxiliary bus bars **211, 212** between which is provided a capacitor **213**. This low voltage is used for current supply to the marker anvil solenoid **79**, to the depresser solenoid **117**, and to brake motor **106**.

Also fed from the main bus bars **200, 201** is a conventional time switch **214**, available on the market so not specifically described here, except to say it is connected to the enlarger lamp or light source **21** and provides a push button **215** for the operator to depress to energize the lamp and obtain exposure of the sensitized strip **23** at the exposure station for the preselected time duration.

A coil of a first relay **216** is connected in parallel with said light source or lamp **21**. This first relay has an armature **217** that normally closes on contact **218** to a line **219** to main bus **201**, and by line **220** through a condenser **221** and rectifier **222** to the other main bus **200**, in consequence of which said condenser **221** is normally charged. At the start of an exposure, current prevails in lines **223, 224** to lamp **31**, and by parallel lines **225, 226** therefrom to the coil of relay **216** that relay is energized, thereby causing armature **217** to break contact with normally closed contact **218** and to complete circuit with another but normally open contact **227** of said first relay **216** to a second relay **228** by way of wire **229**. The other end of the coil of this second relay **228** has connection through aforementioned condenser **221** and line **220** with said armature **217** of the said first relay **216**, so that said condenser **221** then discharges and excites the said second relay **228**. This second relay **228** has an armature **230** which, when activated by said condenser discharge, closes on normally open contact **231** thereof and completes circuit in a line **232** between low voltage bus **212** and the anvil solenoid **93**, causing the anvil to descend and strike strip **23**. The other end of that solenoid coil is connected by wire **233** to the other low-voltage bus **211**. Since this circuit to activate the anvil solenoid **93** is dependent upon condenser discharge, which is brief, the anvil **79** makes its strike and immediately returns to its upward non-engaging position.

Mention may be here interposed, that the marker motor **88** is constantly rotated by current supplied thereto through lines **234, 235** connected respectively to main bus bars **200, 201**. Therefore, whenever the anvil makes its strike, the marker element **78** is rotating and the single line-marking **95** will be applied to the under face of strip **23**.

Previously mentioned lines **225** and **226** feeding from and in parallel to the lamp lines **223** and **224** respectively beyond connections thereof to first relay **216** are shown with one, as **225**, continuing as a shunt line **236** containing a condenser **237** at the other side of which is connected a line **238** having one-way rectifier **239** interposed be-

tween it and said line 226 from the other lamp line 224, so that while the lamp line is receiving current, said condenser 237 is being charged. Said line 238 from the said condenser 237 and one-way rectifier 239 feeds to a third relay 240 the other wire 241 to which leads back to another contact 242 of the first relay 216 and is normally closed by another armature 243 provided by said first relay, said armature 243 being in electrical connection with line 236 and condenser 237. While current is being fed from the lamp line 223, 224 to energize the first relay 216, the second described armature 243 is opened from contact 242 and as a result, the current in the lamp line, via lines 225 and 236 to one side of condenser 237, and via line 226 and one-way rectifier 239 to the other side thereof, charges the condenser. After the exposure period is completed and current to the lamp line discontinued by operation of timer 214, the first relay 216 becomes de-energized and consequently second armature 243 closes to contact 242 completing the condenser circuit through wire 236, armature 243, contact 242, wire 241 to the coil of aforementioned third relay 240 and back to condenser 237 by line 238. As a result, the condenser discharges and momentarily attracts armature 244 to said third relay 240 and breaks circuit with contact 245 thereof to which high voltage is supplied by way of line 246 from auxiliary positive bus bar 208.

The circuit includes first and second thyratrons 247, 248 respectively, the plate current to which is derived through above-described armature 244 and contact 245 of the third relay 240. Interruption of the plate current by opening said armature from its contact, makes certain that the thyratrons are then and thereafter in a non-conductive state until the next film exposure impends.

The plate circuit to the thyratrons 247, 248 from said armature 244 of the third relay is carried therefrom in common or parallel lines 249 to corresponding ends of coils of fourth and fifth relays 250, 251 with the other ends of the coils having wire connections 252, 253 to the anodes 254, 255 respectively of said thyratrons 247, 248. The corresponding cathodes 256, 257 of said thyratrons are in turn connected to intermediate tap points 258, 259 of voltage dividers 260, 261 arranged between the high voltage bus bar 207 and bus bar 208 by way of a resistor 266 and a conductor 208' in continuation of bus bar 208. These voltage dividers 260, 261 are formed each with a resistor 262 or 264 which is considerably larger than the companion resistor 263 or 265 of the respective voltage dividers, and the larger of said resistors are shown as the ones connected through resistor 266 and continuation line 208' to the positive high voltage bus bar 208, whereas the smaller resistors 263, 265 are the ones connected to the high voltage negative bus bar 207. Conseqently said tap points 258 and 259 of the voltage dividers 260, 261, and likewise the thyratron cathodes 256, 257 connected thereto, are slightly positive with respect to negative bus bar 207. The voltage (approximately 75 volts) across the voltage dividers is determined by above mentioned resistor 266 in series therewith, said resistor functioning in conjunction with a gas-filled stabilizer tube 267 in parallel to said voltage dividers which it will be noted are in parallel to each other. Said stabilizer tube connects to the continuation conductor 208' of the positive bus bar 208 at point 268 and to the negative bus bar 207 at point 269.

Another resistor 270 is in the continuation conductor 208' beyond the voltage dividers from positive bus bar 208 and further therebeyond said conductor is secured to the previously described common spring 114 engaging one each, namely, 98 and 99, of the contacts of the pairs of contacts located beneath the horizontal reach 37 of strip 23. The other strip-engaging contact 98' of the first pair has wire connection 271 from the individual spring 113 thereof to the grid 272 of the first thyratron 247, and the other contact 99' of the second pair of contacts has wire connection 273 from the other individual spring 113 thereof to the grid 274 of the second thyratron 248. The grids 272 and 274 of the thyratrons are connected also each in series with respective resistors 275, 276 to the negative bus bar 207 by wires 277, 278 individual to each grid, which results in said grids normally having a negative bias. As the cathodes, as above stated, are somewhat positive, the negative status of the grids of course renders the thyratrons normally non-conductive. However, as soon as either one of the pairs of contacts 98, 98' or 99, 99' is bridged by having the graphite line-marking 95 on strip 23 engaging the same, the corresponding thyratron grid is then and thereby connected to the positive terminal 268 of the voltage stabilizer tube 267 and this immediately renders the corresponding thyratron conductive. Since the plate supply of these thyratrons is furnished by a D.C. voltage, they remain conductive even after the grids cease to be positive, until the plate circuit is interrupted by opening the normally closed circuit of armature 244 from contact 245 by the previously described condenser charge energizing the coil of the third relay 240.

When the first thyratron 247 is rendered conductive, it causes current to flow through aforementioned coil of fourth relay 250. This relay has an armature 279 which is normally open with respect to its contact 280. Said armature 279 has wire connection 281 to auxiliary low voltage bus 211, and contact 280 has a wire connection 282 to brake motor 106 from which there is a return wire 283 to the companion low voltage bus 212. When graphite line-marking 95 activates the first thyratron 247 as above described, said fourth relay is energized, thereby closing the circuit to the brake motor 106, and remains energized, as above explained, as long as current flows in the thyratron and consequently longer than the momentary engagement and bridging of contacts of the pair of contacts 98, 98', by the moving line-marking 95.

The fifth relay 251 functions to close and open the circuit controlling flow of current to the roller actuating motor 97 for the strip 23, to close a circuit to stop said motor instantaneouly, and to close and open the circuit operating the solenoid 117 for depresser 115, controlled by the periods of conductivity and non-conductivity of the second thyratron 248. In greater detail, said fifth relay is shown with two armatures, of which one here identified as double throw armature 284, closes against one contact 285 when the relay is not energized, at which time the armature may be said to be in retracted position, and closes against another contact 286 when the relay coil is energized, and this may be termed the advanced position of the armature. This armature 284 has wire connection 287 to main bus bar 20. Contact 285 at the retracted position of the armature has wire connection 288 to the roller actuating motor 97 that pulls the strip along the horizontal reach 37 thereof. A wire 289 returns from the motor to the other main bus bar 201. The other contact 286 engaged by the double-throw armature in advanced position thereof when the relay coil is energized, has wire connection 290 to the main bus bar 200, but with a one-way rectifier 291 imposed in that wire connection. Between said rectifier 291 and the roller actuating motor 97, a large capacitor 292 (approximately 500 mf.) is located across the main bus bars 200, 201. By virtue of this arrangement, when said double-throw armature 284 advances to close against contact 286, said capacitor 292 discharges across the field coil of the actuating motor 97 for the strip. It is the same armature that has broken the circuit of electrical energy that until then was driving that motor. So by mere shift of said double-throw armature the motor is deprived of the actuating current and practically simultaneously receives the capacitor discharge. Said discharge is short but very intense direct current, and although lack of driving power tends to stop the motor, and although braking his taken place as above described, without said discharge there still would be some further spin of the motor due to mo-

mentum and the uncertainty of amount of spin cannot be tolerated for exact positioning of the strip **23**. The application of the impulse of the capacitor discharge, however, brings the strip actuating motor **97** to a sudden stop. Thus the strip has been advanced rapidly and stopped suddenly, following a short distance of slow-down, in exact measured distance from its starting position.

The second armature, now identified as **293**, of the said fifth relay **251** has wire connection **294** to the low-voltage bus bar **212**. When the said relay is energized, this second armature **293** closes circuit with a contact **295** which has wire connection **296** with depresser solenoid **117**, a return wire **297** therefrom going back to the low voltage bus bar **211**.

At the bottom of FIG. 15, diagrammatic showing is made of the supply reel motor **44** in series with its switch **62** connected in parallel to the receiving reel motor **45** and its series switch **63**, arranged in parallel between lines **298, 299** from the main current bus bars **200, 201**, and these may be under control of a master switch **300**.

In addition to the broad and specific concepts of novel structure and combinations thereof, the invention is to be understood as also directed to unique features of method of unreeling, reeling and feeding the sensitized strip with accuracy of measured distances for the successive positions of the strip, and inclusive of the strip having rapid advancement, short periods of slow-down in approach to the interval of rest, and sudden stopping at the end of the precise measured distance of advancement.

We claim:

1. A photo-reproduction apparatus comprising in combination with a sensitized strip, and a light source and lens system constituting an exposure station at which images are produced as successive frames on said strip, means advancing said strip with a step-by-step motion to successive exposure of frame areas of the strip at the exposure station, means precisely measuring the next approaching frame distance following the frame at the exposure station and predetermine thereby the distance for advancement of the strip, means marking the said distance on the strip at precisely a frame distance from the frame being exposed, thereby exactly defining the length of the next area to be exposed, means stopping the advancement of said strip prior to exposure of said next area precisely at the marked frame position to produce the image frame in exact position on the strip at the exposure station, whereby all frames are of equal and precise length at the exposure station, the said marking on the strip being electrically conductive and the means advancing said strip comprising an electric motor, and said means stopping advancement of said strip comprising an electric circuit activated by and successively including contacts successively engaged by said marking on the strip applying both a braking to rotation of the motor and a sudden stopping thereof at the said precise marked position.

2. A photo-reproduction apparatus comprising in combination with a sensitized strip, and a light source and lens system constituting an exposure station at which images are produced as successive frames on said strip, means advancing said strip with a step-by-step motion to successive exposure of frame areas of the strip at the exposure station, means precisely measuring the next approaching frame distance following the frame at the exposure station and predetermine thereby the distance for advancement of the strip, means marking the said distance on the strip at precisely a frame distance from the frame being exposed, thereby exactly defining the length of the next area to be exposed, means stopping the advancement of said strip prior to exposure of said next area precisely at the marked frame position to produce the image frame in exact position on the strip at the exposure station, whereby all frames are of equal and precise length at the exposure station, the said marking on the strip being electrically conductive and the means advancing said strip comprising an electric motor, and said means stopping advancement of said strip comprising an electric circuit activated by and successively including contacts successively engaged by said marking on the strip applying both a braking to rotation of the motor and a sudden stopping thereof at the said precise marked position, and a depresser located on the apparatus at the opposite face of the strip from the face having said marking for enforcing engagement of said marking with said contacts.

3. A photo-reproduction apparatus comprising in combination with a sensitized strip, and a source of light and lens system constituting an exposure station at which images are produced as successive frames on said strip, a driving motor advancing said strip with a step-by-step motion to successive exposure of frame areas of the strip at the exposure station, means precisely measuring and applying an electrically conductive marking on said strip at the distance of the next approaching frame following the frame at the exposure station, contacts contiguous to said strip engaging said marking on passage of said marking thereat during advancement of said strip, braking means for said motor, and an electric circuit completed by and including said marking conducting electric current controlling said motor and controlling said braking means and effecting a controlled stopping of the strip with a frame located precisely at said exposure station.

4. An apparatus in accordance with claim **3**, wherein means is provided in direct opposition to and on the opposite side of the strip from said contacts, enforcing engagement of said marking against said contacts on advancement of said strip.

5. An apparatus in accordance with claim **3**, wherein said braking means comprises a shaded pole motor mechanically coupled to said driving motor.

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