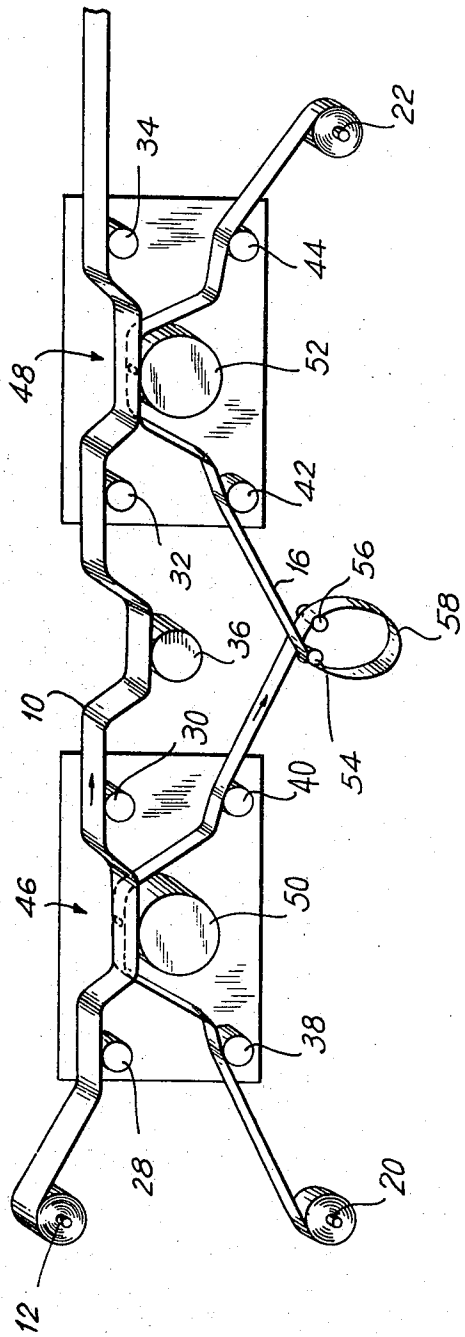
Dec. 24, 1968 S. JEFFEE ET AL 3,418,050

APPARATUS FOR PRINTING MULTIPLE IMAGES ON PHOTOGRAPHIC RAW STOCK AND RELATED FADER

Filed Nov. 2, 1967 12 Sheets-Sheet 1

FIG. 1



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APPARATUS FOR PRINTING MULTIPLE IMAGES ON PHOTOGRAPHIC RAW STOCK AND RELATED FADER
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FIG. 2

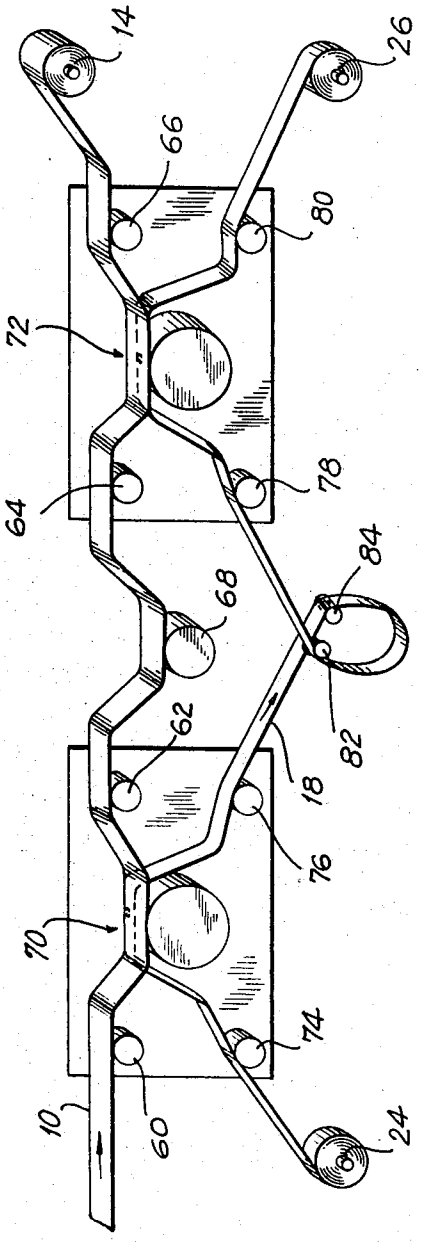
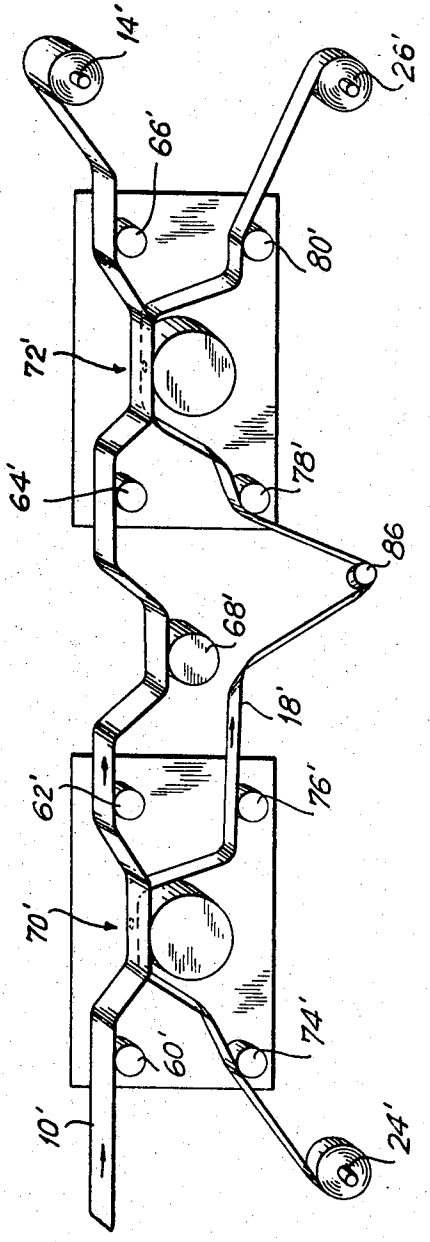


FIG. 3



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APPARATUS FOR PRINTING MULTIPLE IMAGES ON PHOTOGRAPHIC RAW STOCK AND RELATED FADER

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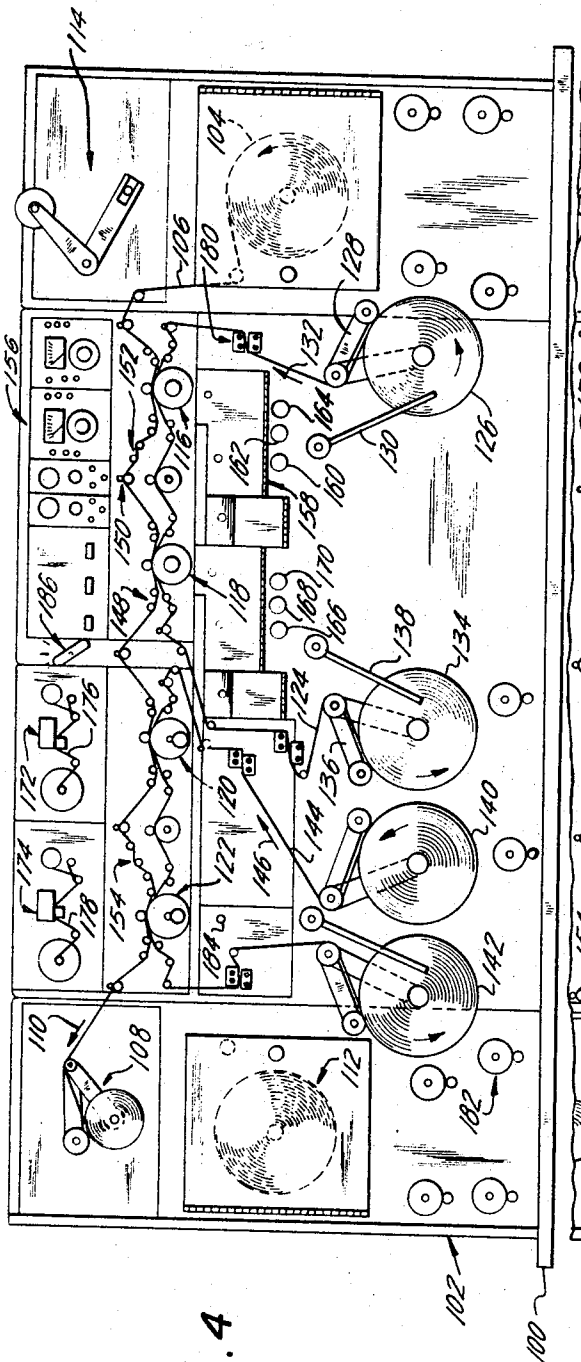


FIG. 4

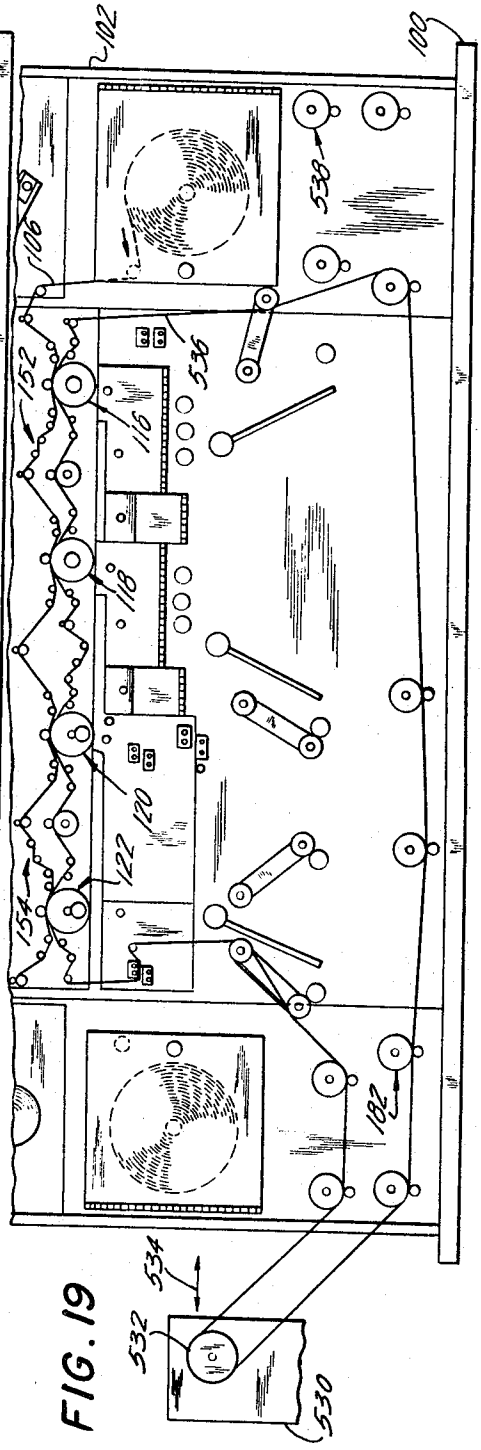


FIG. 19

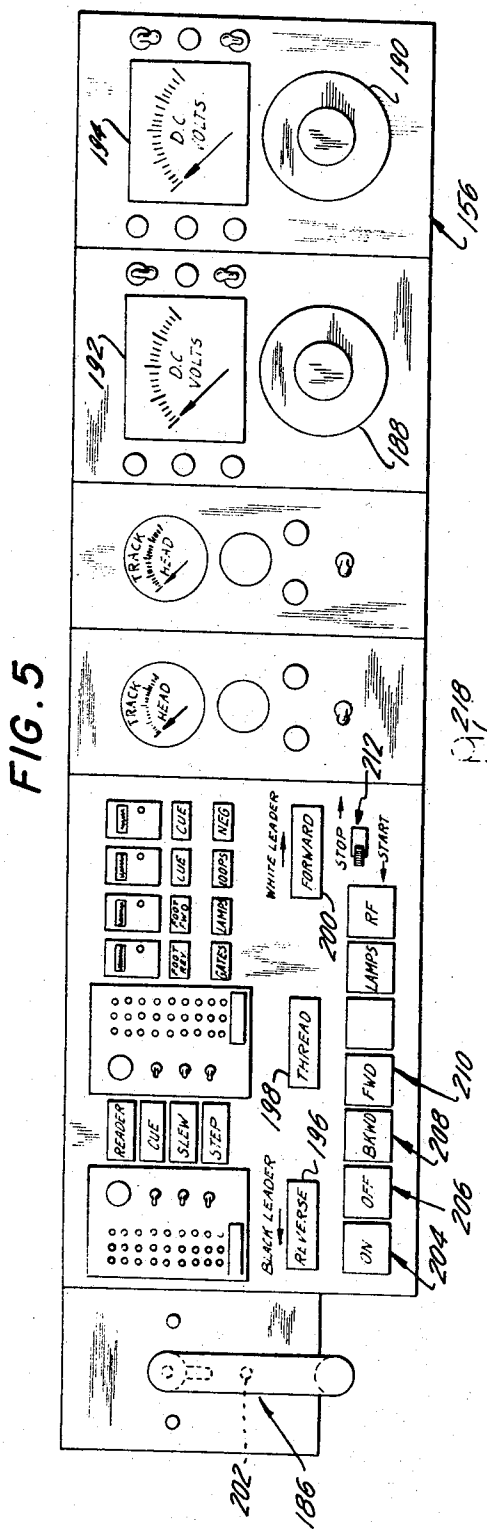

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D.C VOLTS
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FIG. 5

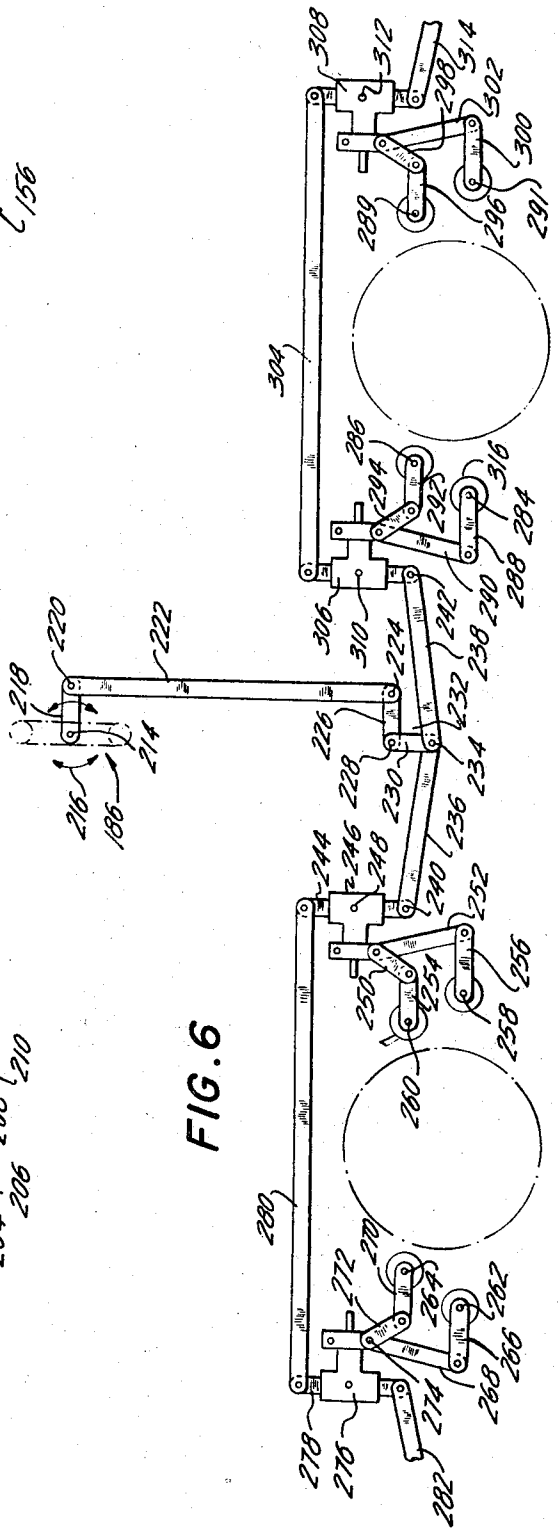

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FIG. 6

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APPARATUS FOR PRINTING MULTIPLE IMAGES ON PHOTOGRAPHIC RAW STOCK AND RELATED FADER

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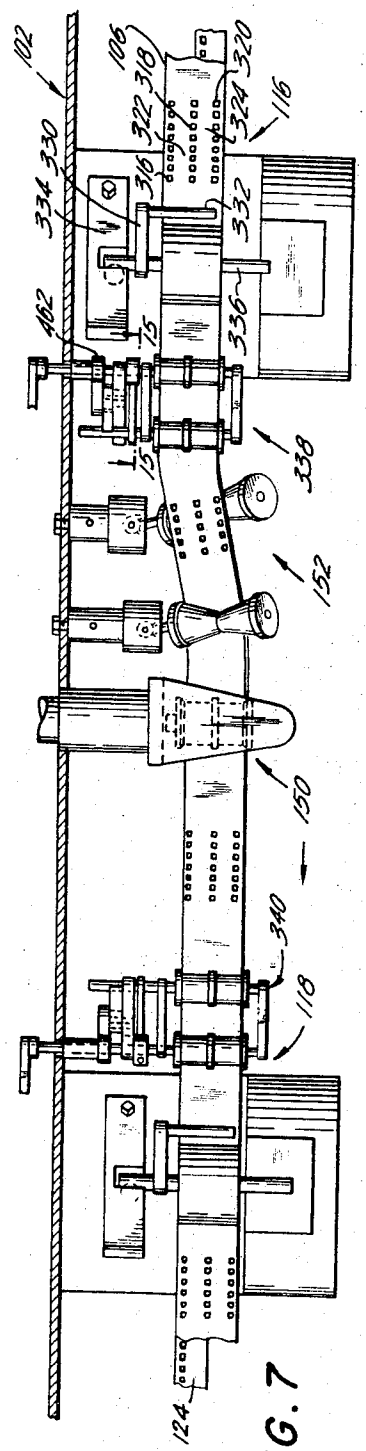


FIG. 7

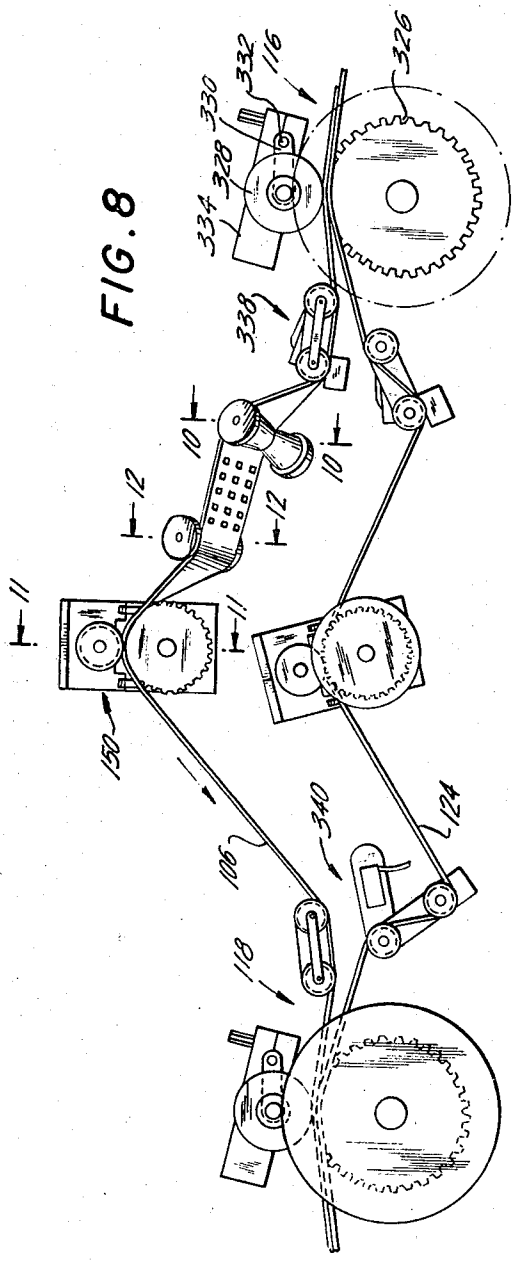


FIG. 8

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APPARATUS FOR PRINTING MULTIPLE IMAGES ON PHOTOGRAPHIC RAW STOCK AND RELATED FADER

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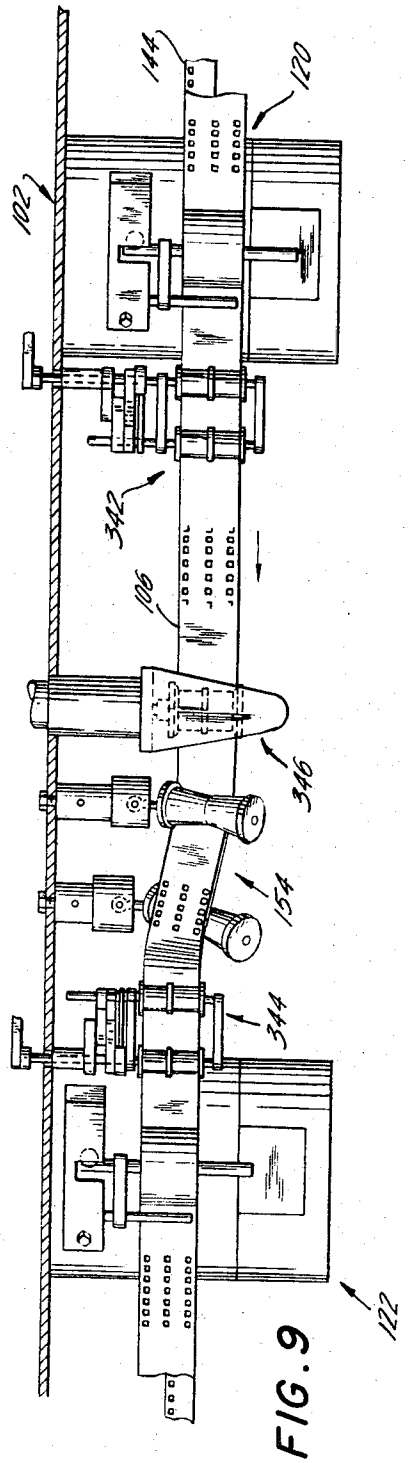


FIG. 9

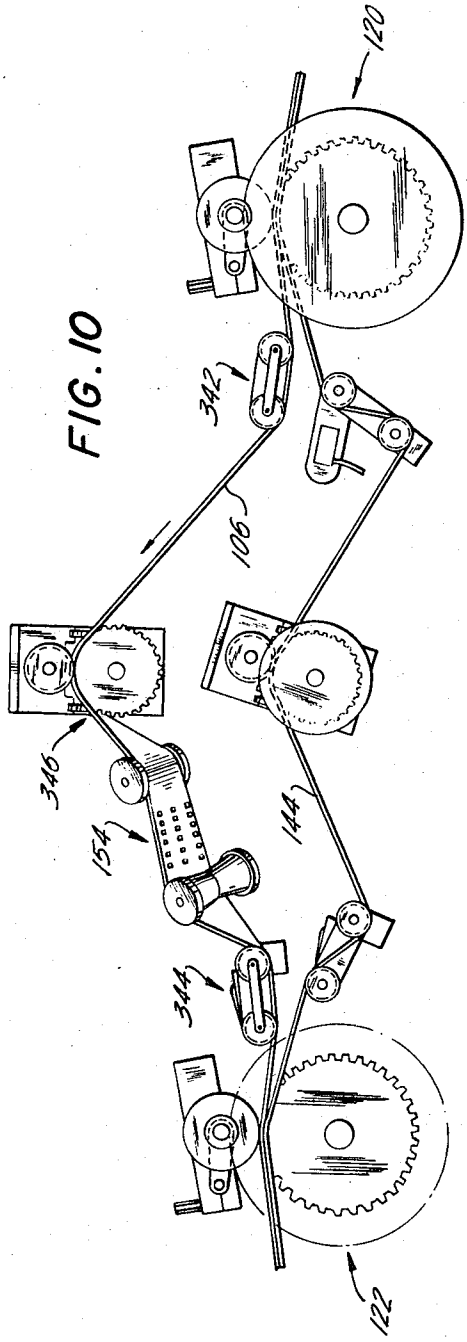


FIG. 10

FIG. 11

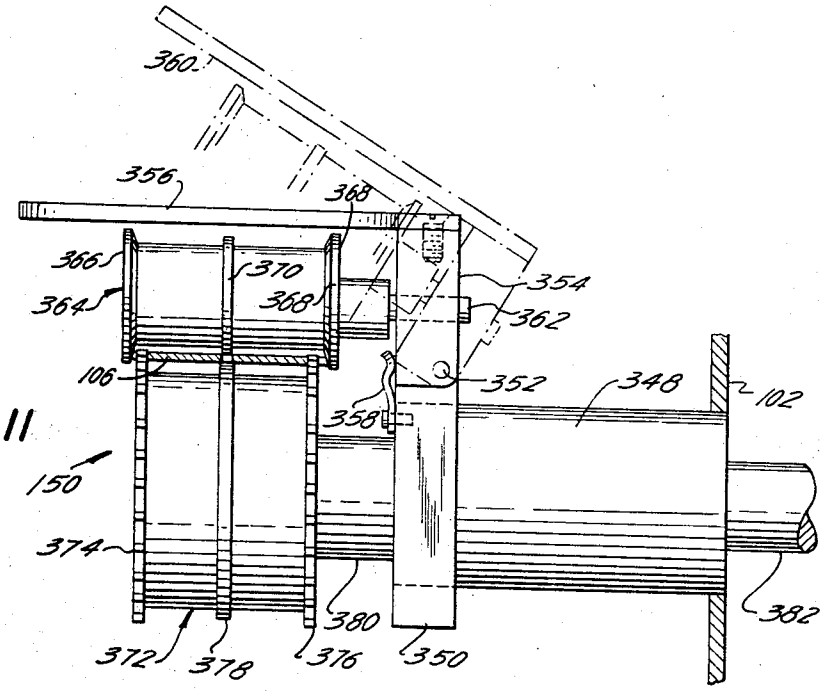


FIG. 12

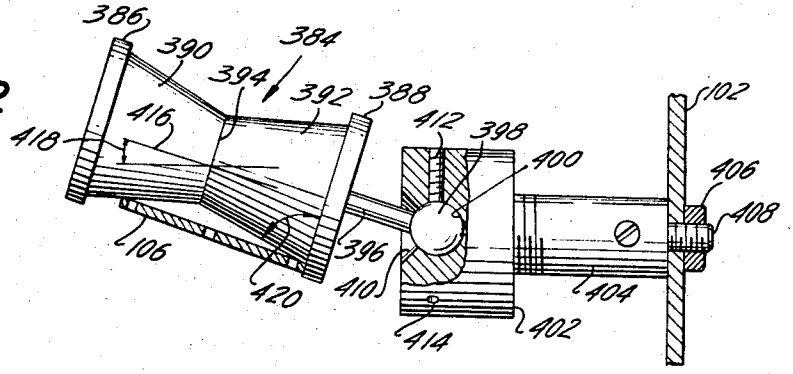
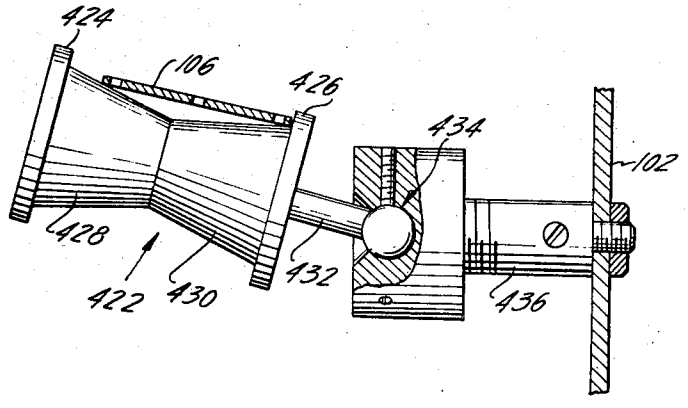


FIG. 13



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FIG. 16

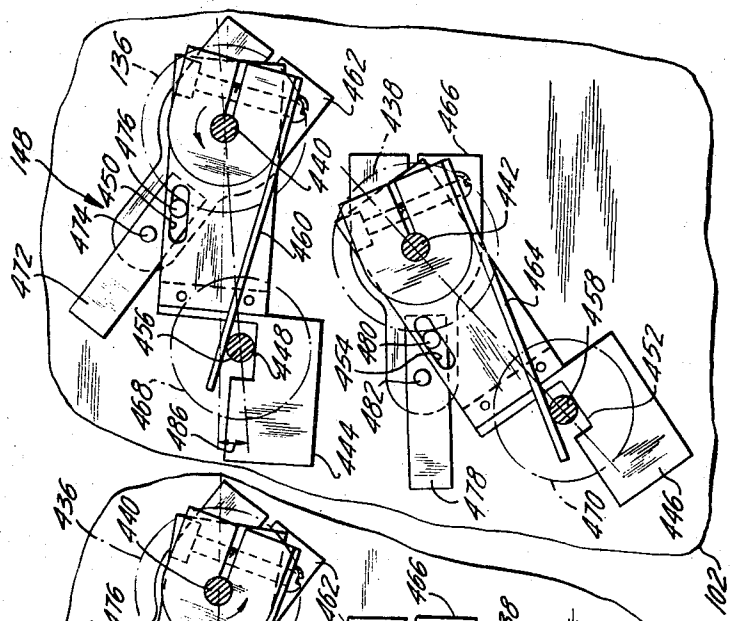


FIG. 15

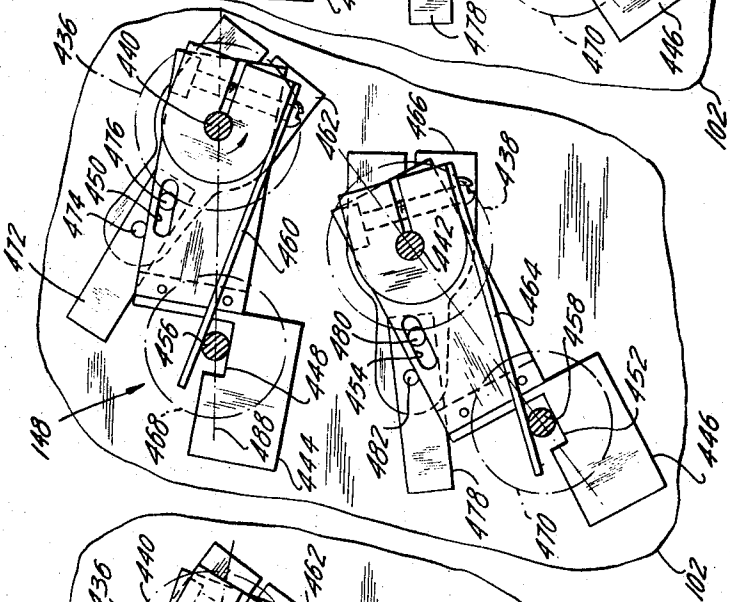


FIG. 14

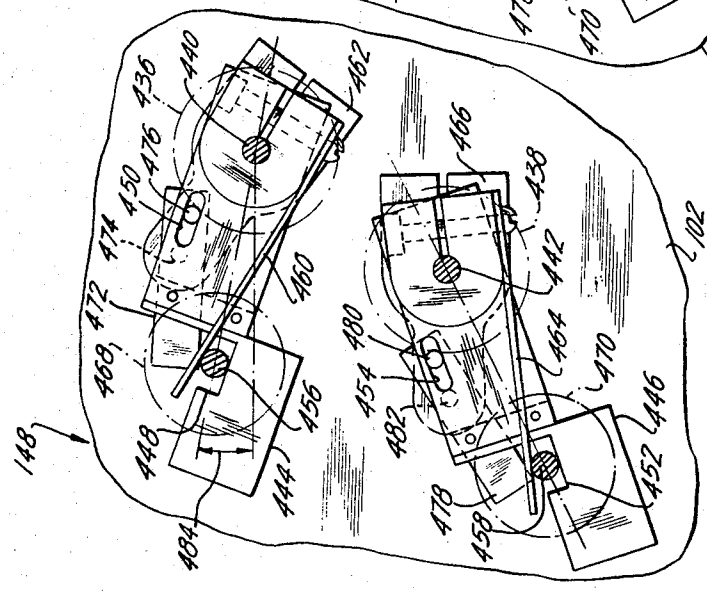


FIG. 17

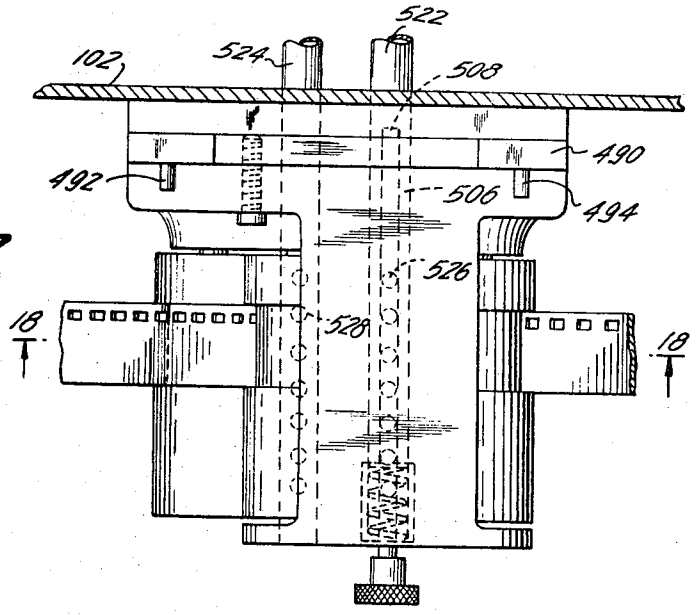
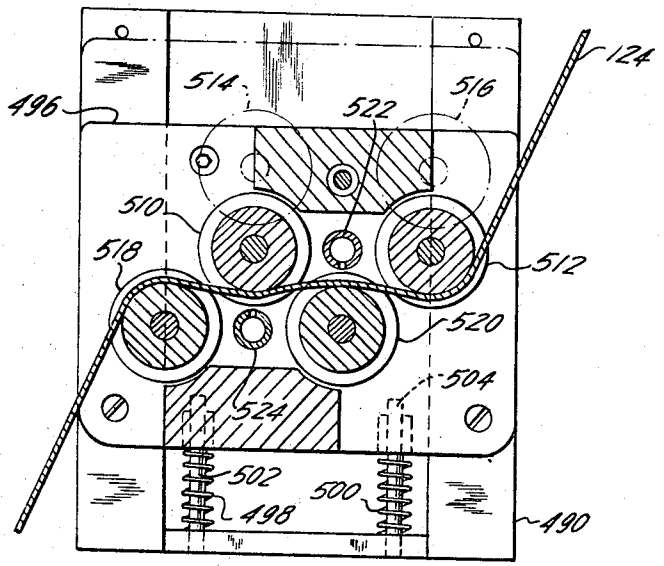

522
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102
508
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494
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18
528
18

FIG. 18


124
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520
504
524
502
500
498
490

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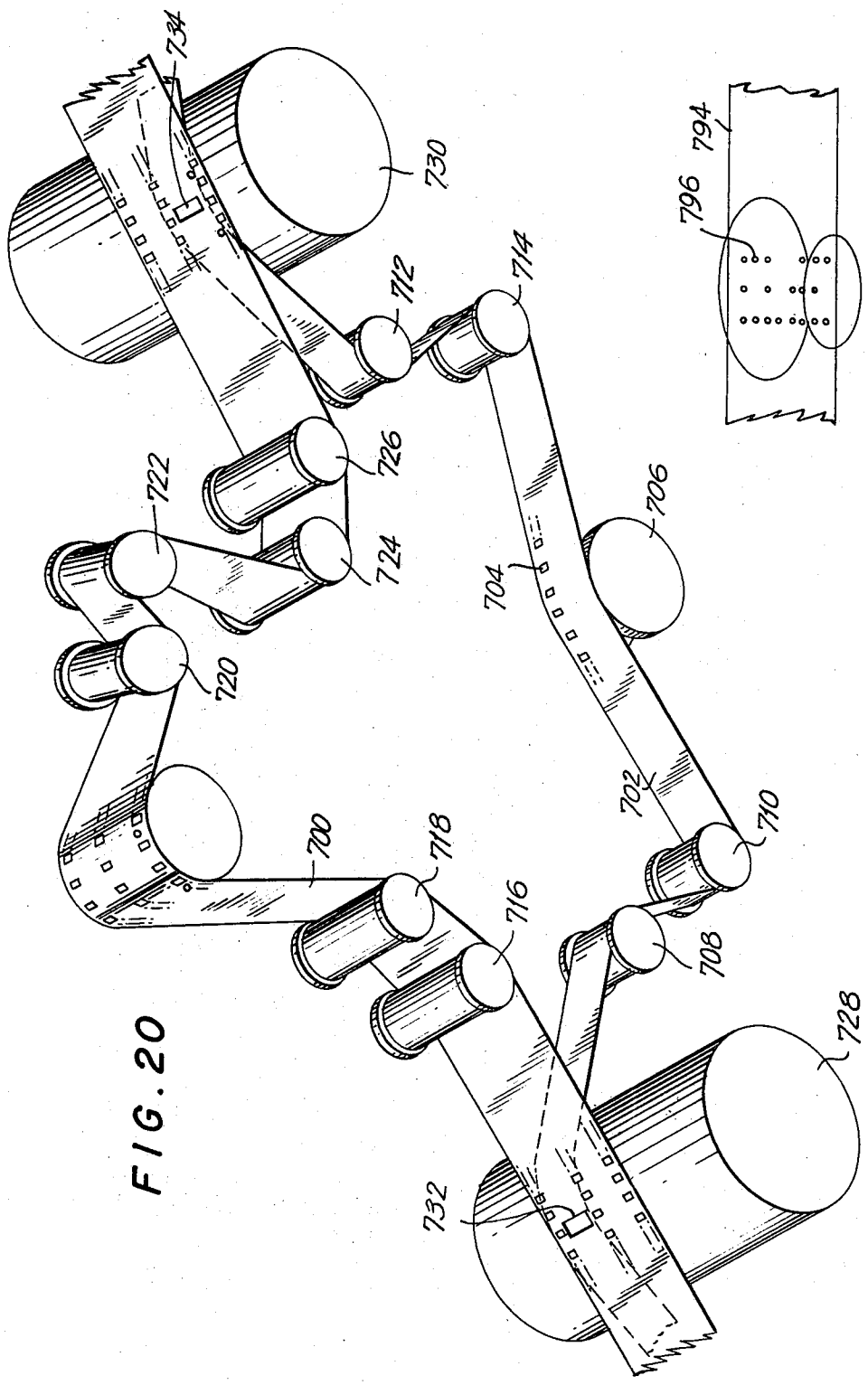


FIG. 20

FIG. 23

FIG. 22

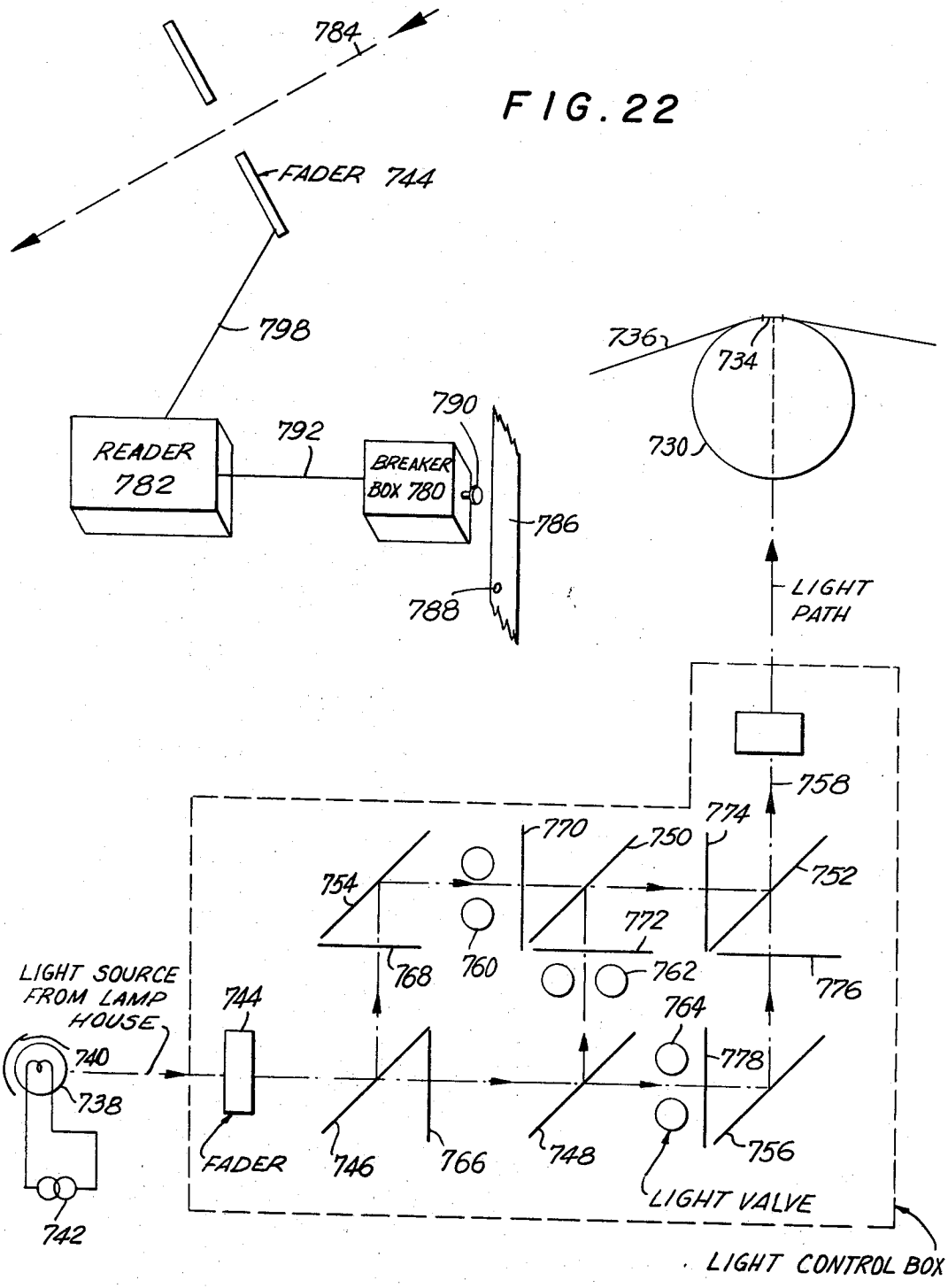

784
FADER 744
798
READER 782
792
BREAKER BOX 780
790
786
788
736
734
730
LIGHT PATH
758
774
770
750
754
752
772
768
760
762
776
764
778
LIGHT SOURCE FROM LAMP HOUSE
740
738
744
FADER
746
766
748
756
LIGHT VALVE
742
LIGHT CONTROL BOX

FIG. 21

United States Patent Office 3,418,050
Patented Dec. 24, 1968

3,418,050

APPARATUS FOR PRINTING MULTIPLE IMAGES ON PHOTOGRAPHIC RAW STOCK AND RELATED FADER

Saul Jeffee, Scarsdale, N.Y., and John J. Kowalak, River Edge, N.J., assignors to Movielab, Inc., New York, N.Y.

Continuation-in-part of application Ser. No. 641,079, Mar. 20, 1967. This application Nov. 2, 1967, Ser. No. 680,134

5 Claims. (Cl. 355—90)

ABSTRACT OF THE DISCLOSURE

A device for printing from a movie film negative onto photographic raw stock in which the negative or the raw stock is shifted laterally relative to the other and the negative is used repeatedly in a single pass for printing on a plurality of parallel strips on the raw stock. The raw stock can then be split to obtain a plurality of positive films. The device also contains vacuum means for cleaning the negative and fader means for securing the desired light properties.

Related applications.—This application is a continuation-in-part of application Ser. No. 641,079 now Patent No. 3,379,111 filed Mar. 20, 1967, which is a continuation-in-part of application Ser. No. 463,301, now abandoned filed June 11, 1965.

Brief summary of the invention.—The method of the invention involves printing multiple images on photographic film raw stock from a single picture negative, the raw stock being at least twice as wide as the negative. This method comprises feeding the raw stock continuously along a predetermined path guiding the negative into juxtaposition with the raw stock at two separate stations by guiding the negative past one of the stations and then shifting the negative and raw stock relatively and transversely of said path and then guiding the same past the next of the stations, printing from the negative onto the raw stock being effected at each of the stations.

The apparatus of the invention comprises guide and driving means for guiding photographic raw stock along a predetermined path, first and second exposure means spaced both along and transversely of the path and juxtaposed with respect thereto, guide and driving means for guiding a negative into juxtaposition with the raw stock and said first and second exposure means and means between the exposure means to shift the raw stock and negative relative to one another and transversely of said path whereby to provide for multiple printings on the raw stock.

Brief description of drawing.—FIGURE 1 is a diagrammatic view illustrating the methods and apparatus of the invention according to one preferred embodiment thereof;

FIGURE 2 diagrammatically illustrates a continuation of the apparatus of FIG. 1;

FIGURE 3 diagrammatically illustrates a modification of the apparatus of FIGS. 1 and 2;

FIGURE 4 is a detailed side view of an apparatus embodying the invention and providing for bringing two negatives into juxtaposition with photographic raw stock at respective exposure or printing stations;

FIGURE 5 is an enlarged view of the control panel of the apparatus of FIG. 4;

FIGURE 6 is a side view of a portion of a linkage system employed to control tensioning means used in the apparatus of FIG. 4;

FIGURE 7 is a top plan view illustrating the exposure zones and shifting means for one of the negatives and associated raw stock in FIG. 4;

FIGURE 8 is a side view of the apparatus of FIG. 7;

FIGURE 9 is a top plan view corresponding to FIG. 7 for the second of the negatives illustrated in FIG. 4;

FIGURE 10 is a side view of the apparatus of FIG. 9;

FIGURE 11 is a view on enlarged scale of a detail of FIG. 4 included in the guiding portion of the structure of FIG. 4 and seen in the direction of arrows **11** in FIG. 8;

FIGURE 12 is a view of a shifting roller employed in FIG. 4 and seen in the direction of arrows **12** in FIG. 8;

FIGURE 13 is a view of a second shifting roller as appears in the direction shown by the arrows **13** in FIG. 8;

FIGURES 14, 15 and 16 are views on enlarged scale of the details of tensioning means employed in the apparatus of FIG. 4, FIG. 15 being a sectional view taken along lines **15—15** of FIG. 7;

FIGURE 17 illustrates on enlarged scale a top plan view of a cleaning device employed in the apparatus of FIG. 4;

FIGURE 18 is a cross-sectional view taken along lines **18—18** of FIG. 17;

FIGURE 19 is a view partially broken away of the apparatus of FIG. 4 employed for driving a single negative along an endless path;

FIGURE 20 is a diagrammatic perspective view of an apparatus for shifting a negative relative to raw stock, emphasizing the positions of the printing head;

FIGURE 21 is a diagrammatic illustration of a source of light operatively associated with the aforesaid printing heads in accordance with a further embodiment of the invention;

FIGURE 22 is a diagrammatic illustration of a control employed in connection with the source of light employed in FIG. 21; and

FIGURE 23 illustrates at data record employed with the apparatus of FIG. 22.

Detailed description.—This invention relates to methods and apparatus for printing on photographic raw stock. More particularly, this invention relates to apparatus and methods for shifting the relative positions of a negative and photographic raw stock transversely of one another in order to permit a multiple printing of parallel images from the negative onto the associated raw stock.

It is an object of the invention to provide improved methods and apparatus which will permit printing from a standard single line picture image or track negative in a double width or other such multiple width raw stock by first enabling a printing in one position and then a successive printing in a second position, preferably in the same direction of movement of the raw stock.

For example, in the case of a 16 mm. picture negative, the negative might first be employed to print in a first position and would then be shifted laterally to print onto a second parallel strip on the raw stock, the negative possibly being shifted through still additional positions which would be determined by the width of the raw stock material employed. Alternatively, the raw stock can be shifted relative to the negative.

In accordance with its principal objective, the invention contemplates a method of printing multiple parallel images on photographic film raw stock from a single negative, the raw stock being at least twice as wide as the negative, the method comprising feeding the raw stock continuously and uni-directionally along a predetermined path and guiding the negative into juxtaposition with the raw stock at two separate stations by guiding this negative past one of the stations and then shifting the negative or raw stock or both transversely of said path and guid-

ing the same past the next of the stations, printing being effected from the negative onto the raw stock at each of the said stations.

According to one feature of the invention, the shifting can be effected through a helical course. Alternatively, the invention contemplates that the negative or raw stock can be passed through a course having reversed skews therein.

According to still a further feature of the invention, it is contemplated that the length of the path of the raw stock between the stations be compensated to account for the shifting of the negative and to align the images printed on the raw stock transversely relative to each other.

In further keeping with the invention, there is contemplated an apparatus for the multiple printing of picture and soundtrack negatives of determinable width in spaced parallel relation on a wider strip of photographic raw stock.

The apparatus, in accordance with a preferred embodiment of the invention, will comprise supply means for the supply of the raw stock and receiving means for receiving the raw stock with guide and driving means being provided for guiding the raw stock from the supply means to the receiving means along a predetermined path.

In further accordance with the invention, there is provided first and second exposure means spaced along and transversely of the aforesaid path and juxtaposed with respect thereto, there being further provided a source of said picture negative and means for taking up the same with guide and driving means being provided for guiding the picture negative into juxtaposition with the raw stock at the aforesaid first and second exposure means.

Additionally there is contemplated the provision of means between the aforesaid exposure means to shift the picture negative transversely of the path by passing the same through a helical loop having an axis transverse to the aforesaid path or by passing the picture negative through a path having skewed portions therein.

Additionally there may be provided a source of soundtrack negative and means for taking up the same with further exposure means being spaced along and transversely of the aforesaid path and juxtaposed with respect thereto, there being further provided guide and driving means for guiding the soundtrack negative into juxtaposition with the raw stock at said further exposure means with means being provided between the further exposure means to shift the soundtrack negative as aforesaid, whereby a multiple printing can be effected.

The above and other objects and features of the invention will be more clearly understood from the following detailed description of some preferred embodiments of the invention as illustrated in the accompanying drawing.

In FIGS. 1 and 2 the raw stock strip is indicated at **10** and is constituted by a single continuous strip of photographic film raw stock originating at a source **12** diagrammatically indicated and received by a film take-up mechanism **14** also diagrammatically indicated.

Operatively associated therewith is a picture negative or negative strip **16**, as well as a second negative strip **18**, which provides the soundtrack associated with the film sequence on the first negative **16**.

Negative strip **16** originates at source **20** and is taken up by take-up mechanism **22**, whereas negative strip **18** originates at source **24** and is taken up by receiving device **26**.

Strips **16** and **18** may preferably be of equal width but are not necessarily so related. These strips are, however, of lesser width than raw stock **10** so that each strip can be juxtaposed against the raw stock **10** in a plurality of parallel alignments in order to effect the printing of multiple parallel images on the raw stock **10**.

It will, of course, be appreciated that it is desirable that a soundtrack be provided adjacent and in operative association with each sequence of images generated from the picture negative **16** and the technique for effecting this will be readily understood from the disclosure which follows hereinunder.

Relative to the picture negative **16**, the raw stock **10** is driven along a predetermined and continuous path by guide and driving devices **28** and **30** on the first hand and subsequently by guide and driving devices **32** and **34** which engage the raw stock in conventional manner, as will be well known to those skilled in the art.

Between the sets of guide and driving devices **28** and **30** on the one hand and **32** and **34** on the other, there is positioned a further guiding device **36** which engages the raw stock **10** to serve a purpose which will hereinafter be indicated in greater detail.

Operatively associated with the picture negative **16** directly are guide and driving devices **38** and **40** on the one hand and **42** and **44** on the other hand. These devices serve to drive the negative strip **16** into juxtaposition with the raw stock **10** at spaced exposure stations generally indicated at **46** and **48**, whereat exposure devices **50** and **52** expose the raw stock to the images on the picture negative **16** at stations which are spaced from one another longitudinally along the film as well as transversely of the path of the raw stock.

Stated otherwise, and by way of example, the strip **16** passes adjacent the raw stock **10** at the back half of the latter at station **46**, whereas the strip **16** passes adjacent the raw stock **10** at the front half of the latter at station **48**.

To provide for transversely or laterally shifting the negative **16** to accommodate the transverse displacement of the exposure stations, the negative **16** is shifted laterally by guiding devices **54** and **56**. These devices **54** and **56** constitute a means for shifting the picture negative transversely of the path of the raw stock by passing the picture negative through a helical loop **58**, having an axis which is transverse to the path of the raw stock **10**, said loop **58** being of one or more turns as is necessary, and providing for a lateral or transverse shift of said negative **16**.

From the above it will be observed that the technique of the invention involves guiding a negative into juxtaposition with raw stock at spaced and sequential exposure stations by guiding the negative past one of the stations and then shifting the negative laterally or transversely of the path of the raw stock by passing the strip along a helical course having an axis transverse to the path of the raw stock and then guiding the negative past the next of the related exposure stations.

In further accordance with the invention, the strips of images which are printed in parallel relation on the raw stock **10** are preferably transversely aligned so that scene changes, titles, and so forth are aligned and can be dealt with with facility. The aligning of the adjacent parallel strips is effected by means of the guide **36**, which alters the length of raw stock between the adjacent and sequential exposure stations to compensate for the length of the helical loop **58**. Thus, where the loop **58** is made larger, the device **36** is adjusted to increase the length of the raw stock passed between stations **46** and **48** so as to provide for aligning the parallel strips of images which are printed on said raw stock.

The raw stock **10** passes continuously into the second phase, whereat is employed the soundtrack negative **18**, and in the second phase of the apparatus are employed guide and driving devices **60**, **62**, **64** and **66**, which engage and drive the raw stock **10** in a manner described above. Similarly there is associated with the raw stock a further guiding device **68**, the purpose of which is to adjust the length of the raw stock between exposure stations **70** and **72**, as has been described hereinabove.

Operatively associated with the soundtrack negative **18** are guide and driving devices **74**, **76**, **78** and **80**, the purpose of which is similar to the devices **38**, **40**, **42** and **44** described above.

It will be understood that the details of the guide and driving devices are conventional, and well known to those skilled in the art, so that a detailed description thereof is not essential to an understanding of the invention.

As with the first phase of the apparatus, there are provided guides **82** and **84**, the purpose of which is to pass negative strip **18** along a helical path of one turn or more, this in turn providing for the lateral shift of the negative so that parallel adjacent strips of images can be printed on the raw stock **10**. The raw stock and the negative strips **16** and **18** can be driven in synchronism by conventional means.

In addition it will be noted that the use of a helical loop is merely one form of providing an inclined path for the negatives employed with the raw stock, the inclination providing for the lateral or transverse shifting of the negatives relative to said raw stock.

FIG. 3 illustrates a modification of the apparatus of FIGS. 1 and 2 in that the inclined path is provided by means of a skewed roller **86** which, in cooperation with for example roller **78**, presents a reversibly skewed path which enables the associated negative to be shifted laterally or transversely of the path of the raw stock **10**.

It follows from the description above relative to the helical loop that the skewed path provided by guide or roller **86** will also permit a multiple printing of images on the raw stock **10** as is contemplated within the scope of the invention.

From what has been stated above, it will be appreciated that there is provided in accordance with the invention a method of printing multiple parallel images on photographic film raw stock from a single negative or two such negatives, the raw stock being wider than the said negatives and the method comprising feeding the raw stock continuously and unidirectionally along a predetermined path while guiding the negative or negatives in juxtaposition with the raw stock at two separate stations by guiding the negative past one of the stations and then shifting the negative transversely of the path and then guiding the negative past the next of said stations.

It will be further appreciated that the invention contemplates that the negative be shifted by passing the same on a path which is inclined relative to that of the raw stock, such as by passing the negative through a helical course or along a path having reversed skews therein.

As has been indicated hereinabove, a detailed embodiment of the invention is illustrated in FIGS. 4–19, wherein appears an apparatus generally comprising a base **100** upon which is mounted a frame **102**. A source of raw stock is indicated at **104**, the raw stock **106** being received by a take-up indicated generally at **108**. The raw stock in this situation is being fed in the direction indicated by arrow **110**, this being normally termed the reverse direction. When the raw stock being run in the reverse direction **110** is exhausted, an alternative supply and take-up are employed for operating the device in forward direction. Such a supply is indicated generally at **112** with the take-up mechanism therefor being indicated at **114**. Under the condition pertaining to forward operation of the apparatus, the raw stock will follow a path substantially identical with that employed for the reverse operation but being a mirror image thereof, the raw stock being driven from a supply **112** to take-up device **114**.

Printing or exposure stations are generally indicated at **116**, **118**, **120** and **122**. Exposure stations **116** and **118** are intended for one negative such as, for example, the negative containing picture images, whereas the exposure stations **120** and **122** are intended for a second negative having thereon, for example, a soundtrack. The first negative **124**, having thereon the picture images, is supplied by a source **126** mounted on a linkage system **128** and with which cooperates a bracket system **130** which prevents undesired lateral displacement of the negative on its spool. The negative travels in the direction indicated by arrow **132** and is received by a take-up roll **134** mounted on a linkage system **136** and with which cooperates a pivoted bracket device **138** which assures that the negative being wound on the take-up **134** is not laterally displaced off the same.

Similarly, a supply **140** and take-up device **142** are provided for soundtrack negative **144** which travels in the direction indicated by arrow **146**.

The negatives and raw stock are guided into juxtaposition at exposure stations **116**, **118**, **120** and **122** by guiding and driving means including but not limited to a system of tension applying rollers, a pair of which are indicated, by way of example, at **148**. This guiding and driving system, moreover, comprises a plurality of sprocket systems, one of which is generally indicated by way of example at **150**. In addition, and as a characteristic feature of the invention, there are employed shifting rollers generally indicated at **152** and **154**. The details of these various members will be described more particularly hereinafter.

The apparatus of FIG. 4 moreover comprises a control panel generally indicated at **156** and a lighting control generally indicated at **158**. Since the lighting control will not be described in greater detail hereinafter, it will now be noted that any commercially available system will be employed which provides for controlling, for example, light magnitudes and which may provide for the separate control of the magnitudes of red, green or blue light for the printing of colored films. For example, control knobs **160**. **162** and **164** are shown for controlling red, green and blue lights respectively in unit **158** for exposure station **116**, whereas control knobs **166**, **168** and **170** are shown for controlling red, green and blue lights respectively for exposure station **118**. Similar controls may be provided in respect of exposure stations **120** and **122**, although since these stations will generally be related to a soundtrack negative, the same detailed controls as are employed with respect to stations **116** and **118** will not normally be required for stations **120** and **122**.

Also indicated in FIG. 4 are automated controls **172** and **174**. The details of these automated control systems do not directly pertain to the instant invention and it is sufficient to note that whereas the manual control knobs **160–170** noted hereinabove provide for manual control of the lighting, this lighting can be and preferably is controlled during the running of the apparatus by these automated control systems which include perforated control tapes **176** and **178** which are actuated by cues on the negative to set up the optimum lighting conditions for the sequence of scenes being printed from the negative of supply **126** onto raw stock **106**.

In addition to the above generally indicated features of the invention, there are also provided cleaning devices, one of which is indicated generally by way of example at **180**. In addition, a plurality of supplemental guiding means are provided, one of which is generally indicated by way of example at **182**.

The principal object of the invention is achieved, by way of review, by feeding the raw stock **106** along a determinable path and by selectively juxtaposing negatives **124** and **144** with said raw stock adjacent exposure stations **116**, **118**, **120** and **122**. In the embodiment being described, the negative is laterally stationary and it is the raw stock **106** which is laterally shifted. Thus, after being juxtaposed with negative **124** at station **116**, raw stock **106** is shifted laterally by shifting device **152** before being again juxtaposed with the negative **124** at station **118**. In effect, this brings the negative against the raw stock at spaced parallel strips so that two parallel printings result. In conjunction with the above, negative **144** is brought against raw stock **106** at one position represented by exposure station **120** and the raw stock is then laterally shifted by shifting device **154** before the raw stock and negative **144** are again juxtaposed at exposure station **122**.

It will be understood that the displacement occurring between the two printed strips as between stations **116** and **118** is relatively unimportant but that it is possible to arrange it so that the two identical series of images are printed on the raw stock in perfect alignment. More important, however, is the alignment of the soundtrack from negative **144** with the picture images resulting from negative **124** since the sound track and picture images must be perfectly aligned to obtain the optimum printed product. To this end it is necessary to stagger negative **144** by a predetermined amount with respect to the running of negative **124**. It has been found possible to effect this by means of a synchronization pin **184** whereby the negative **144** at the outset is provided with a cue which is matched with the synchronization pin **184** to provide a loose loop, the take-up of which must be effected before additional negative **144** is drawn from supply **140**. The taking up of this initially provided loose loop offsets the running of negative **144** relative to negative **124** so that the soundtrack will be perfectly matched with picture images.

Provision is made in the apparatus of FIG. **4** for the threading of the raw stock and the negatives and for the tensioning of the raw stock and negatives as required for running in both forward and reverse directions. The control for this is indicated at **186** and will be discussed in greater detail hereinafter.

The control panel **156** is illustrated in greater detail in FIG. 5, it being seen that rheostats **188** and **190** are provided with meters **192** and **194** whereby the operating voltages of the apparatus are controlled. Lights **196, 198** and **200** indicate whether the machine is adapted for forward or reverse operation or for threading. Control **186** is pivoted about an axis **202** to control a linkage system as will hereinafter be described in greater detail. On and off switches for the electrical power are indicated at **204** and **206** with reverse and forward switches being indicated at **208** and **210**. The running of the apparatus can be initiated and stopped by switch **212**.

Control **186** also appears in FIG. 6 whereat is indicated pivot **214** which is fixed but rotatable as indicated by arrow **216**. Link **218** is mounted on pin **214** and is rotatable therewith. This link is connected by pivot pin **220** to elongated link **222** in turn connected by pin **224** to link **226**. Link **226** is connected to fixed but rotatable pin **228** to which is connected link **230** for movement in the directions indicated by arrow **232**. Link **230** is connected by pin **234** to generally horizontal links **236** and **238** at the ends of which are respectively provided pivot pins **240** and **242**. To the pin **240** is connected a link **244** on which is mounted bracket **246** having a pin **248** therein. This bracket is connected via pivotal links **250** and **252** to links **254** and **256** respectively. At the end of link **256** is a fixed but rotatable pivot **258** and at the end of link **256** is provided a fixed but rotatable pivot **260**. These pivots **258** and **260** are rotatable in order to control related members as will hereinafter be described in greater detail.

In a similar manner, pivots **262** and **264** are controlled by links **266** and **268** and **270** and **272** respectively, these being connected by a pin **274** to a bracket **276** mounted on a link **278** coupled to link **280**. Link **282** indicates an extension of the system to still further pivots.

Also indicated in FIG. 6 are fixed but rotatable pivots **284** and **286** controlled by links **288** and **290** and **292** and **294** respectively. Pivots **289** and **291** are also shown and are respectively controlled by links **296** and **298** and links **300** and **302**.

Link **304** intervenes between pivots **284** and **286** on the one hand and pivots **289** and **291** on the other, there being also provided brackets **306** and **308** having pivots **310** and **312** respectively. Pivots **248** and **310** and those of brackets **276** and **312** are fixed but rotatable. Link **314** is shown to indicate the extension of the system to still further fixed but rotatable pivots.

The operation of the aforegoing link system will be referred to in greater detail hereinafter. It is sufficient to note at this point that with each of the various terminal pivots noted hereinabove there is associated a roller such as indicated by way of example at **316** and a second roller (not shown in FIG. 6) associated with this first roller to cooperate therewith to provide tension in the related negative or strip or raw stock.

In FIGS. 7 and 8 appear the frame **102** of the apparatus and the raw stock **106** and negative **124**. In FIGS. 9 and 10 appear the frame **102**, raw stock **106**, and negative **144**. Exposure stations **116** and **118** and **120** and **122** are also shown in respective of FIGS. 7–10.

Referring to FIG. 7 by way of example, it is seen that raw stock **106** includes three rows **316, 318** and **320** of sprocket holes which extend longitudinally along the entire strip of raw stock. These rows effectively divide the raw stock into two strips **322** and **324** which correspond in width to the width of the negatives **124** and **144** and on each of which strips the negatives **124** and **144** will both be printed. Considering first and solely negative **124**, this will be printed in strip **322** and will also be printed in strip **324**. Negative **144** will also be printed with its soundtrack in correspondence to the two printings of negative **124** on both of strips **322** and **324**.

As appears by way of example in FIG. 9, for example, the negative **144** travels a straight line and is not laterally displaced. The raw stock **106** is, however, laterally displaced by the shifting device **154**. The same relationship applies in repect of shifting device **152** in FIG. 7. More particularly, the raw stock **106** is shifted laterally by an amount corresponding to the width of negative **124** in FIG. 7 and is shifted laterally in an opposite direction by the width of negative **144**, as shown in FIG. 9 at **154**.

Referring in greater detail to FIGS. 7 and 8, the exposure station **116**, which is conventional and provides for the transmission of light through the negative to the raw stock, comprises a drive sprocket **326** which engages the sprocket holes in the raw stock and negative film to drive the same through the exposure station in perfectly aligned relationship. Sandwiching the raw stock and negative against the sprocket **326** is a roller **328**. To this roller is connected a lever **330** having a rod **332** connected thereto. By these means, the roller **328** can be manually adjusted on its shaft **336** in support block **334** for movement away from the sprocket **326** to facilitate threading.

Further illustrated in FIGS. 7 and 8 are tension means **338** and **340**, the details of which will be hereinafter indicated in greater detail. Similarly, the details of the idler guide means **150** will be hereinafter made apparent.

FIGS. 9 and 10 show tensioning devices **342** and **344** as well as guiding device **346**. The details of tensioning means **342** and **344** correspond to those of tensioning device **338**, as disclosed hereinafter. Similarly, the details of shifting device **154** correspond to the details of shifting device **152** and the details of guiding device **346** correspond to those of guiding device **150**, also referred to in greater detail hereafter.

More particularly, the details of guiding device **150** and therefore of guiding device **346** appear in FIG. 11 wherein is seen the frame **102**. Mounted on the frame **102** is a support **348** on which is mounted a vertical supporting member **350**. A pivot pin **352** is installed in member **350** and supports through the intermediary of vertical member **354** a horizontal lever **356**. Normally lever **356** is retained in the position shown in solid lines by means of leaf spring **358**. However, the lever **356** may be tilted upwardly to the position indicated at **360** upon manual engagement and against the force of said spring **358**. This tilted condition facilitates threading.

A shaft **362** is mounted in member **354** and it supports a spool **364** having end flanges **366** and **368** and central flange **370**. The spool sandwiches raw stock **106** against sprocket **372** having annular sets of teeth **374** and

376 and a central set of teeth 378. The sprocket 372 may either idle on shaft 380 or may be driven through shaft 382 provided that the necessary synchronism is provided in respect of the driving sprocket of the corresponding exposure station.

The characteristic details of the elements of the shifting device 152 appear in FIGS. 12 and 13, these details also constituting the details of shifting device 154.

In FIG. 12 is illustrated a roller 384 having end flanges 386 and 388 at the bases of truncated conical sections 390 and 392. These control sections are coaxial and are joined together at the narrow portions, as indicated at 394. Roller 384 idles on shaft 396 at the end of which is a ball 398 accommodated in a socket 400 in support 402. Support 402 is in turn mounted on a rod 404 connected by a nut 406 and bolt 408 to frame 102. A conical recess 410 is provided which permits a limited universal-type adjustment of shaft 396, ball 398 rotating in socket 400. Set screws are indicated generally at 412 and 414 to enable shaft 396 to be adjusted and locked in position. This adjustment is generally empirically determined to retain raw stock 106 against flange 388, a minimum contact being desired as between the raw stock and said spool 384 to enable the shifting to be effective without stressing the raw stock and to avoid scratching of the raw stock.

More particularly, the axis 416 of spool 384 will generally assume an angle 418 to the horizontal or, in other words, to the normal plane of the raw stock, which angle generally runs from about 10 to 40 degrees. The axis 416 will moreover lie within a range of about 10 to 40 degrees relative to an imaginary line transverse to the raw stock. The base angle of the conical sections indicated at 420 will preferably run within a range of about 50–80 degrees.

Whereas the raw stock 106 runs beneath the roller 384 of FIG. 12, it runs above the roller 422 of FIG. 13. This latter roller comprises end flanges 424 and 426 of annular configuration and comprises further truncated conical sections 428 and 430 of the same configuration as the corresponding sections in FIG. 12. Similarly, roller 422 is mounted on a shaft 432 adjustable by ball and socket means 434 supported by support 436 on frame 102.

As appears by way of example in FIGS. 7 and 8, rollers 384 and 422 are inclined relative to the raw stock and as well relative to one another. The upstream roller of this pair of rollers functions to shift the raw stock from, for example, a horizontal plane to a skewed plane whereas the downstream of these rollers functions to return the raw stock to the horizontal plane from the skewed plane. The adjustability feature of these rollers is significant in adjusting the same to the speed and nature of the raw stock involved.

FIGS. 14–16 show the details of the tensioning devices related to the linking system of FIG. 6 and generally heretofore indicated at 148 in FIG. 4. FIG. 14 shows the condition of the tensioning devices desired for a threading operation whereas FIGS. 15 and 16 show the conditions desired for reverse and forward operating conditions respectively. FIG. 15 in particular corresponds to the condition of the tensioning means under the conditions obtaining in FIGS. 7 and 9, and it may be generally assumed that reference characters 148 and 388 (FIG. 7) identify corresponding devices. Before a detailed discussion is undertaken in respect of the apparatus in FIGS. 14–16 and for purposes of orientation with the linking system of FIG. 6, it will now be remarked that the roller 316 of FIG. 6 finds its counterpart or equivalent in the form of rollers 436 and 438 in FIGS. 14–15.

The apparatus of FIGS. 14–16 comprises fixed but rotatable pins 440 and 442 on which rollers 436 and 438 are respectively mounted (refer generally to FIG. 6 to note how pins 440 and 442 are rotated). Supporting members 444 and 446 are respectively mounted on pins 440 and 442 for being pivoted thereby. Supporting member 444 is provided with an opening 448 and with a slot 450. Supporting member 446 is provided with an opening 452 and with a slot 454. A pin 456 is accommodated in opening 448 and a pin 458 is accommodated in opening 452. A leaf spring 460 mounted on a support 462 (see also FIG. 7) functions to confine pin 456 in opening 448. Similarly, a leaf spring 464 mounted on a support 466 functions to confine pin 458 in opening 452. Supports 462 and 466 are fixed on frame 102. Rollers 468 and 470 are respectively and rotatably mounted on pins 456 and 458.

A member 472 is pivotable on a pin 474 fixed on support member 462. Pivotal member 472 includes a pin 476 which rides in slot 450. In the lower part of the structure is provided a pivotal member 478 having a pin 480 which rides in slot 454, pivotal member 478 being pivoted on pin 482 fixed to supporting member 466.

From what has been described with respect to the linking system of FIG. 6, it appears that pivots 440 and 442, as well as the remainder of the corresponding pivots throughout the system, are pivotable under control of control member 186. As pivots 440 and 442 are pivoted, they carry with them pivots 456 and 458, thereby changing the positions of rollers 468 and 470 relative to rollers 436 and 438. The new stock or negative film, following a serpentine path between these pairs of rollers, thereby follows a more or less tortuous path between these pairs of rollers and therefore has a greater or lesser tension applied thereto. This tension may generally be indicated by the angles shown respectively at 484 in FIG. 14 and 486 in FIG. 16, this angle being equal to zero in FIG. 16, all angles being considered in respect of a horizontal plane passing through the axis of pin 440 and indicated at 488 in FIG. 15. The above function of adjusting tension is however not the only function performed by the apparatus in FIGS. 14–16. More particularly, in FIG. 14, for the threading operation, pivotal member 442 is caused to pivot about pin 474 to engage either directly or through the intermediary of spring 460 against pin 466 whereupon to lock roller 468 against rotation. Similarly, pivotal member 478 is brought directly or through the intermediary spring 464 against pin 458 to lock roller 470 against rotation. In this manner, and for the threading operation, the pivotal motion of pins 440 and 442 are employed to lock rollers 468 and 470 in fixed position. It is to be noted that this locking function is not achieved under the conditions illustrated in FIGS. 15 and 16 wherein pivotal members 472 and 478 are not engaged with the pins of the respective rollers.

FIGS. 17 and 18 illustrate the details of the cleaning devices heretofore indicated at 180 in FIG. 4. These details apply as well to the other cleaning devices employed in the apparatus. Mounted on frame 102 is a plate 490 bearing stop pins 492 and 494. Slide plate 496 is slidable vertically relative to plate 490 under the influence of springs 498 and 500 mounted on pins 502 and 504 respectively. Upward movement of slide plate 496 is normally prevented by means of pin 506 accommodated in a detent 508. Rollers 510 and 512 are mounted on slide plate 496 and are displaceable with the same to the positions indicated at 514 and 516, whereupon a threading operation can be readily effected. Normally, however, rollers 510 and 512 are in cooperative relationship with and juxtaposed with respect to rollers 518 and 520 mounted on plate 490. With the rollers so disposed in cooperative relationship, the negative such as, for example, negative 124 passes along a serpentine path between the rollers, along which path are disposed vacuum devices 522 and 524. These vacuum devices are tubes provided with rows 526 and 528 of perforations through which a vacuum is applied to the film to remove foreign substances therefrom.

FIG. 19 shows the apparatus applied in the case where a single negative is run along an endless path. The ap-

paratus includes, as noted above, frame **102** on base **100** and additionally comprises a loop cabinet **530** having a roller **532** mounted thereon and displaceable in opposite directions, as indicated by arrow **534**. In this case, the exposure stations **116**, **118**, **120** and **122** appear and the raw stock **106**, along with a single negative **536** are transmitted along respective paths juxtaposed at the exposure stations and laterally shifted at shifting stations **152** and **154**. In the illustrated arrangement, however, the previously noted negative supplies are not employed and the negative **536** is arranged in endless fashion to pass through auxiliary guides **182**, the provision of which was noted herein above. Supplemental guides **538** are employed for purposes of positioning loop cabinet **530** at the other extremity of the device.

In the apparatus, which has been described above, the primary type of operation is indicated in FIG. 4. For operation, a reel of raw stock is provided to constitute raw stock supply **104** and control **186** is adjusted for a threading operation. The raw stock is threaded through the respective guiding and drive devices, as well as through the exposure stations, and is engaged with the shifting devices, the details of which have been described above. The raw stock is coupled to take-up device **108**. The first, or picture image negative, is provided by supply or reel **126** and is threaded through the respective cleaning devices, guiding devices, driving devices and exposure stations and thence to take-up device **134**. Similarly, negative **144** is threaded through its corresponding devices. Some of negative film **144** is stripped from supply **140** and a cue thereon is brought to the synchronization pin **184**. The control **184** is then adjusted, for example, to reverse operation, this depending on where the raw stock supply has been positioned as well as the relative position of the negatives. This operates through the roller and linkage arrangement noted hereinabove to apply appropriate tension to the film. The machine is now ready to be started under the control of the control panel. Knobs **160–170** are employed for a first manual light setting, as will be typical of the negatives and raw stock employed. When the machine starts, however, perforated tapes **176** and **188** will control the operation of light control unit **158**. Negative **124** will print on one strip of raw stock **106** at exposure station **116** and at a second parallel strip of the raw stock at exposure station **118**. Negative **144** will be correspondingly printed on the raw stock at stations **120** and **122**. At the termination of one step in the operation, the negatives will be on their respective take-up reels ready for running in the opposite directions. A new reel of raw stock will then be provided at **112** for take-up at take-up unit **114**. Cues can be provided at the ends of the negatives to function in cooperation with tapes **176** and **178** to halt automatically the running of the device.

In the description of the above apparatus little mention has been made of the source of light employed for printing on the raw stock from the negative film associated therewith in laterally displaced position.

Referring next to FIG. 20, a strip of raw stock **700** is illustrated in association with a negative film **702**. The negative film **702** is provided with sprocket holes **704** engaged by a sprocket guide **706**, the negative film being guided along its path of travel by guide rollers **708**, **710**, **712** and **714**. The raw stock **700** is driven along its path of travel by guide rollers **716**, **718**, **720**, **722**, **724** and **726**, the rollers **720** and **722** providing for shifting the raw stock laterally in the manner which has been described in greater detail above.

Also illustrated in FIG. 20 are printing heads **728** and **730**, respectively provided with apertures **732** and **734** through which light is passed in order that the image on the negative be transferred to the raw stock.

In accordance with a further embodiment of the invention, the light passing through apertures **732** and **734** is varied by a fader device illustrated diagrammatically in FIG. 21. In FIG. 21 is illustrated, for example, the printing head **730** with the aperture **734**, the negative and raw stock being indicated in the collective form of a strip **736**.

A light source **738** is provided with a reflector **740**, the light source being operated by a source **742** of electricity. The light passes from source **738** through a fader **744** and is guided and reflected or partially passed by semipermeable mirrors **746**, **748**, **750** and **752** in cooperation with fully reflective mirrors **754** and **756** in such a manner that the light is broken into different spectral components and thereafter recombined to form a single ray or beam of light **758**, each of the spectral components being controlled by a light valve **760**, **762** or **764** which is of a known construction, the details of which will be obvious to those skilled in the art.

In addition to the aforesaid mirrors, filters **766**, **768**, **770**, **772**, **774**, **776** and **778** are employed for purposes of breaking the light into its different spectral components as aforesaid.

The magnitude of the light is controlled by means of the fader **744**, the controlling element of which is of a known construction the details of which will be obvious to those skilled in the art. The control of this fader is effected, for example, as illustrated in FIG. 22.

In FIG. 22 are illustrated a breaker box or detector **780** and a reader **782**, the reader **782** being coupled to and controlling the fader **744**, which is a controllable iris for controlling the beam of light **784** coming from the source **738** of FIG. 21.

The negative film such as, for example, film **786**, is provided with a series of signals or indicia **788**, the purpose of which is to signal when a different light magnitude is required in respect of the printing operation. The indicia **788** is, for example, illustrated in FIG. 22 in the form of a notch which is detected by a feeler **790** included in the breaker box or detector **780**.

The presence of a notch is transmitted via electrical line **792** to the reader **782**, into which is incorporated a data record such as the punched tape **794** illustrated in FIG. 23.

In FIG. 23 the tape **794** is shown as comprising coded combinations of holes **796**, each row of which identifies a different light magnitude. When the breaker box **780** detects a signal on the film **786**, the reader **782** steps to the next row of coded combinations of holes **796** and the reader **782** operates via connection **798** to open or close fader **744** according to the directions on tape **794**.

There will now be obvious to those skilled in the art many modifications and variations of the structure set forth hereinabove. These modifications and variations will not depart from the scope of the invention if defined by the following claims.

What is claimed is:

1. Apparatus comprising guide and driving means for guiding photographic raw stock along a predetermined path, first and second exposure means spaced both along and transversely of said path and juxtaposed with respect thereto, guide and driving means for guiding a negative into juxtaposition with said raw stock at said first and second exposure means, means between said exposure means to shift said raw stock and negative relative to one another and transversely of said path whereby to provide for multiple printings on said raw stock, third and fourth exposure means spaced from said first and second exposure means and along and transversely of said predetermined path, and second guide and driving means to guide a second negative into juxtaposition with said raw stock at said third and fourth exposure means; said apparatus further comprising cleaning means for cleaning

at least one of said negatives, said cleaning means including at least one vacuum applying tube extending transversely of said one negative and means for guiding said one negative in a serpentine path past said tube.

2. Apparatus as claimed in claim 1 comprising fader means operatively associated with at least one of said exposure means to supply a variable source of light for printing on said raw stock.

3. Apparatus as claimed in claim 2, wherein indicia are provided on said negative and said fader means includes detecting means to detect the indicia on said negative, the indicia signalling changes to be made in light magnitude for printing.

4. Apparatus as claimed in claim 3, wherein said fader means includes a data record of light magnitudes and reader means responsive to the detector means for reading from said data record to control the light magnitude.

5. Apparatus as claimed in claim 4 comprising means to divide the light into different spectral components to control the magnitude of each component and to recombine said components.

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U.S. Cl. X.R.

355—111