Oct. 14, 1947. G. M. DYE ET AL 2,428,790

METHOD AND APPARATUS FOR PROCESSING STRIP OF PHOTO PRINT PAPER

Filed Aug. 28, 1943 6 Sheets-Sheet 1

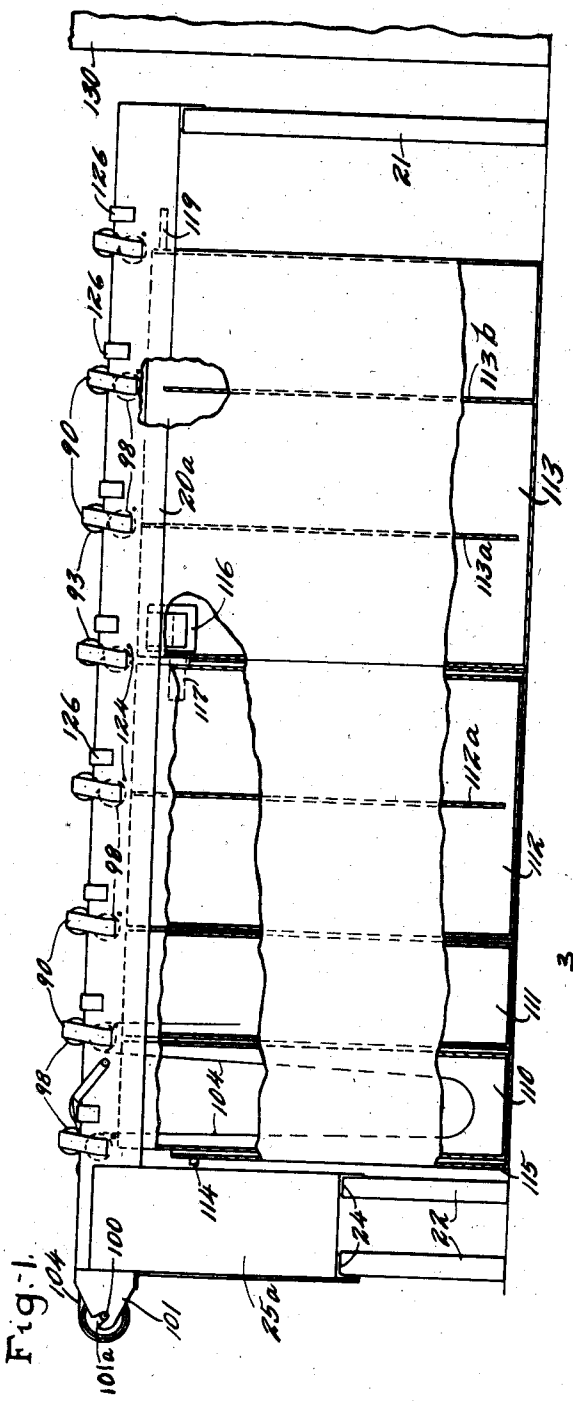

Fig. 1.

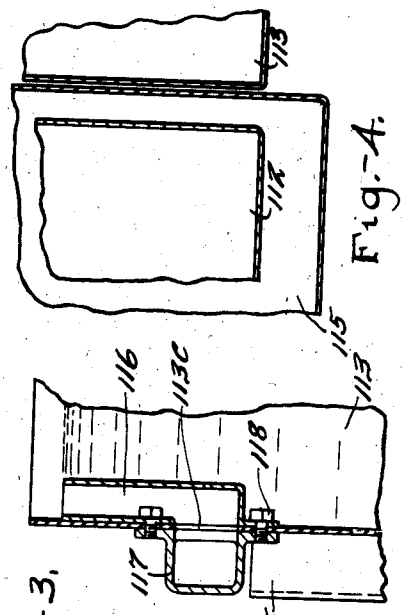

Fig. 4.

Fig. 3.

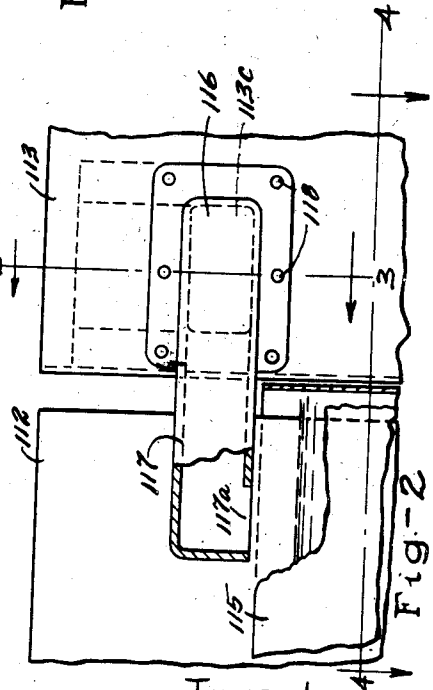

Fig. 2.

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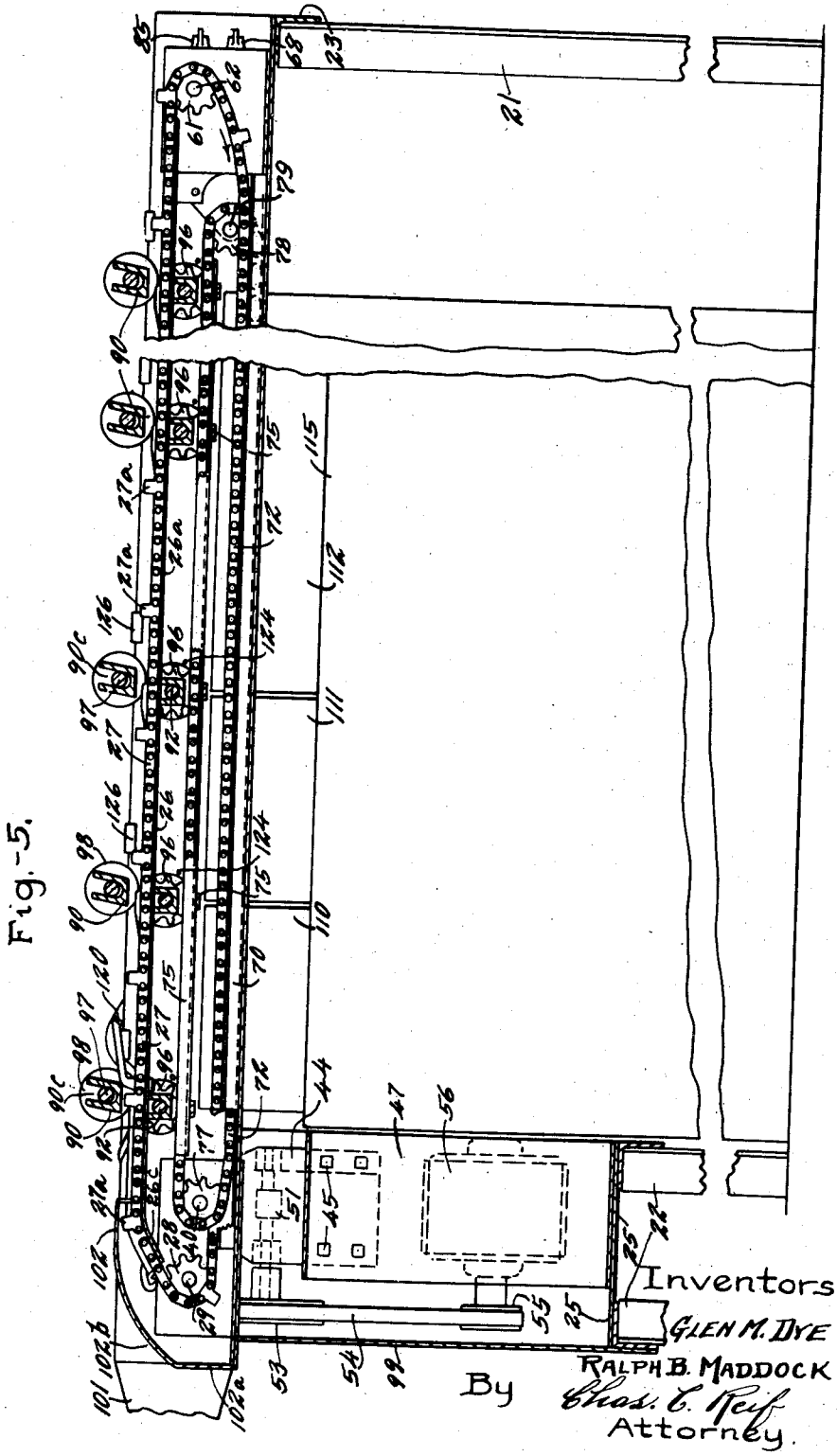

Fig. -5.

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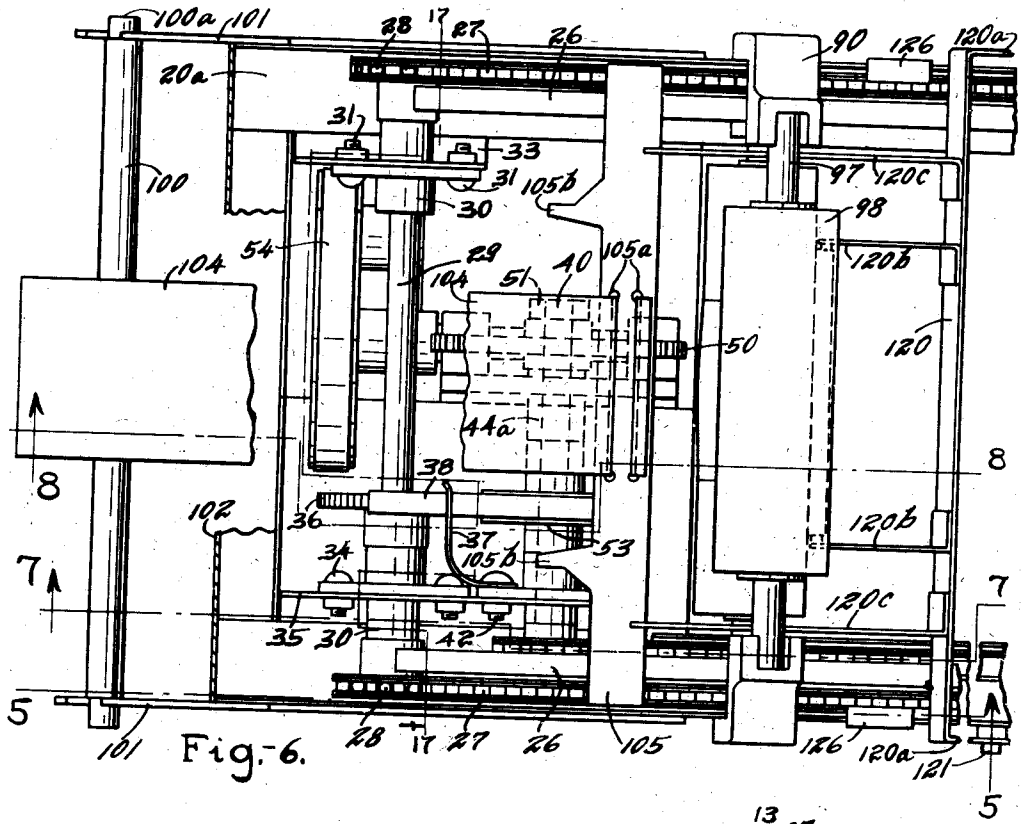

Fig.-6.

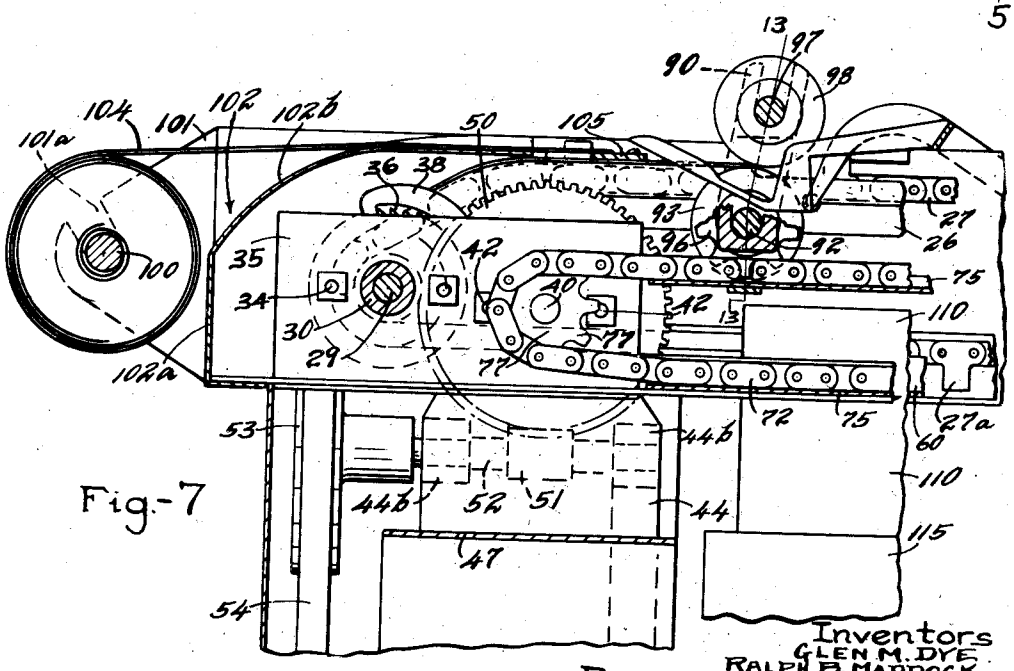

Fig.-7

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Fig. 8.

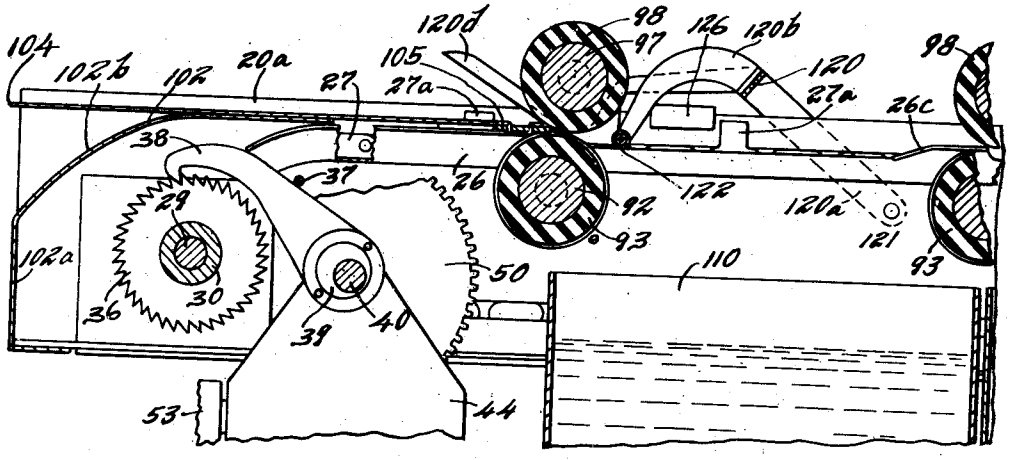

Fig. 9.

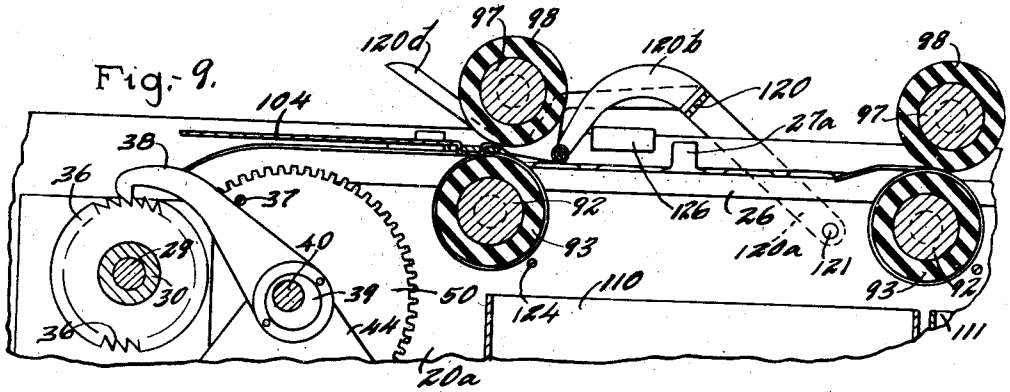

Fig. 10.

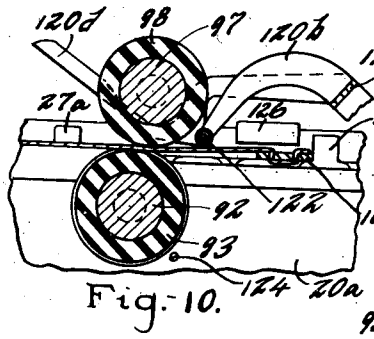

Fig. 11.

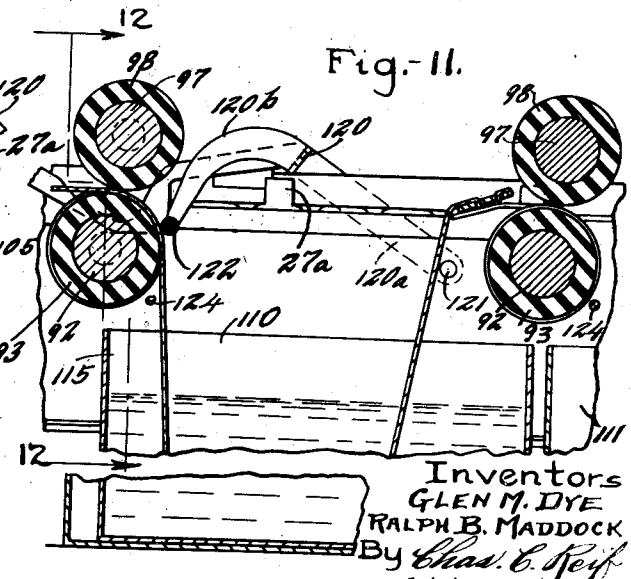

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Fig.-12.

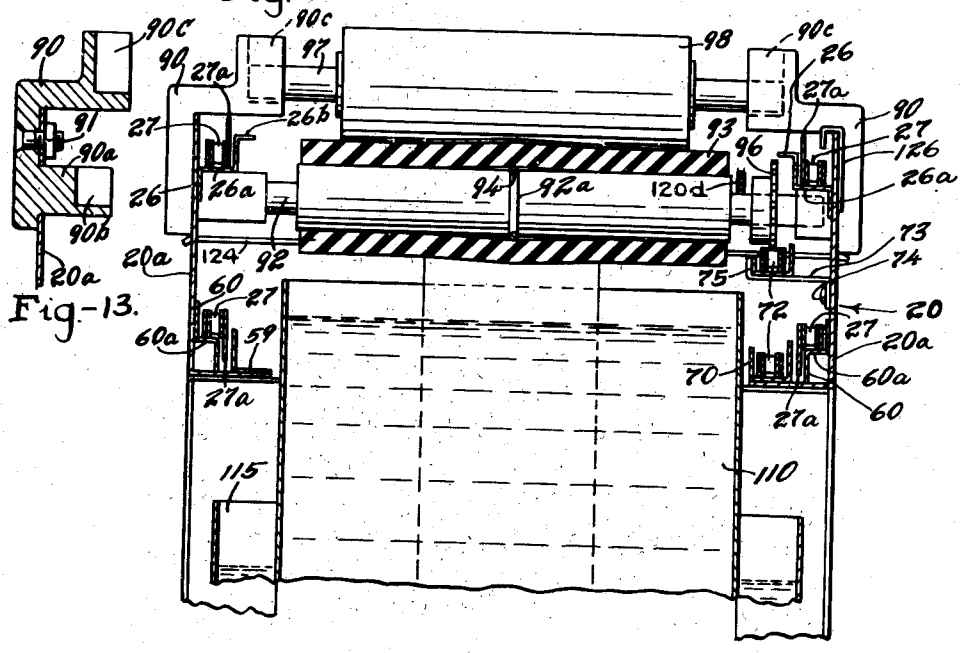

Fig.-13.

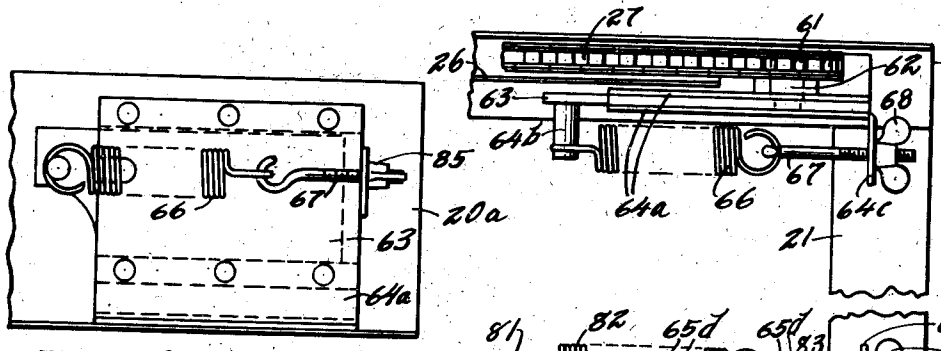

Fig.-15.

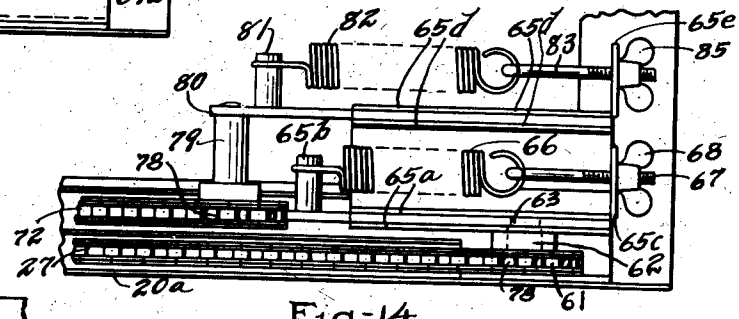

Fig.-14.

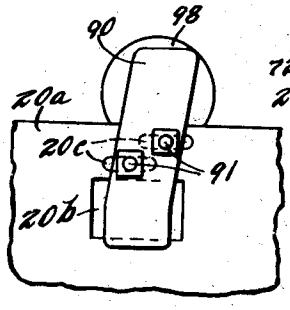

Fig.-16

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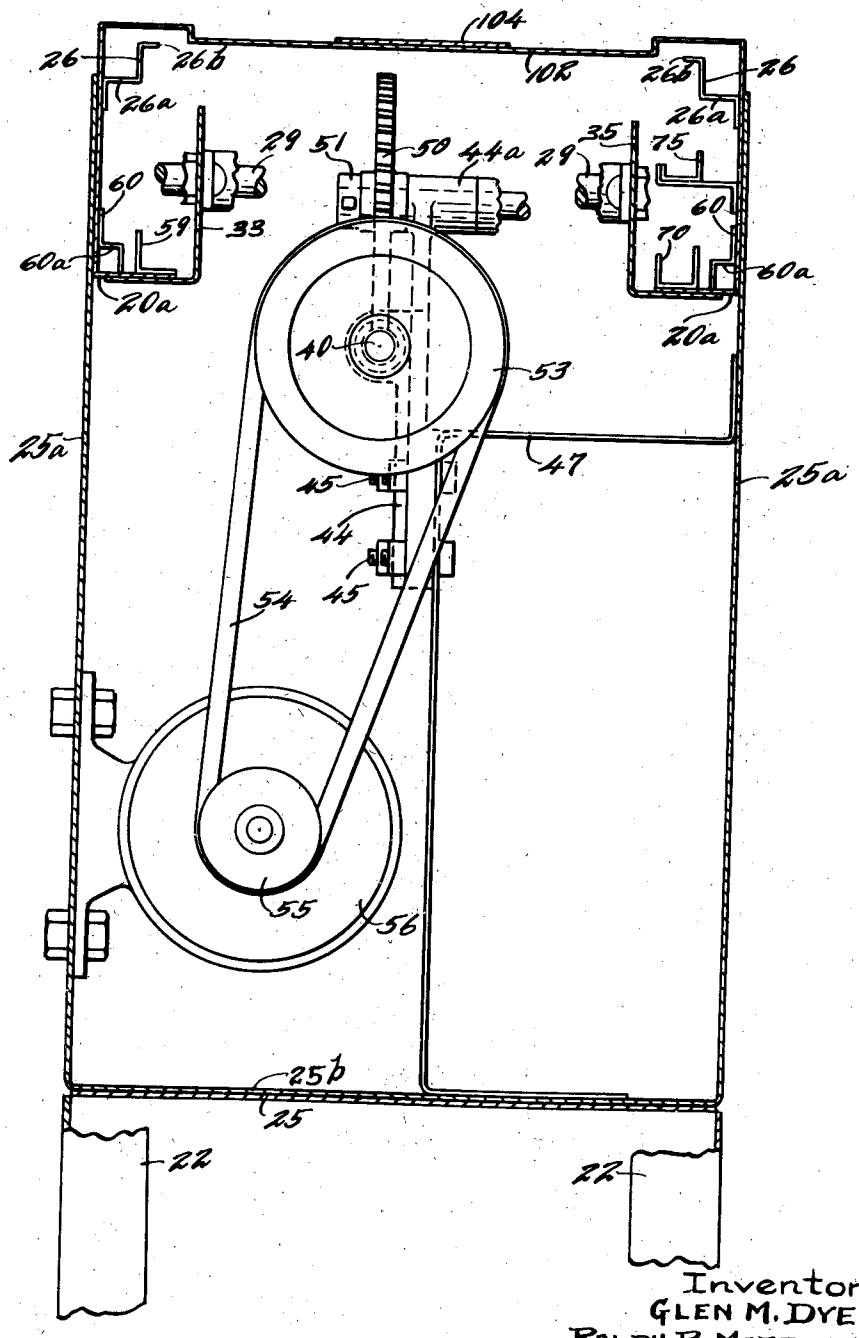
Fig.-17.



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UNITED STATES PATENT OFFICE

2,428,790

METHOD AND APPARATUS FOR PROCESSING STRIP OF PHOTOPRINT PAPER

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Application August 28, 1943, Serial No. 500,366

35 Claims. (Cl. 95—94)

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This invention relates to a method and apparatus for processing a continuous elongated strip of flexible material through a liquid or liquids. While the method and apparatus could be used for processing strips of many kinds of material such as in curing, coating, impregnating and developing operations, etc., the method and apparatus are specifically described and illustrated in connection with processing a strip of sensitized photographic material such as a photographic print paper. It has heretofore been the common practice by operators, both amateur and those in commercial establishments to develop a film and then cut the film into the parts containing the individual pictures. These cut films are then printed with a printing machine, pieces of print paper of corresponding size being used. These individual pieces of print paper are then processed, by developing, fixing, washing, etc.

It is an object of this invention to provide a method and apparatus for quickly, continuously and efficiently processing an elongated continuous strip of material through one or more liquids.

It is another object of the invention to provide a method and apparatus for efficiently processing an elongated continuous strip of flexible material through liquids in which said strip is progressed through a plurality of receptacles containing the various liquids, the speed of the strip being controlled so that any part of the strip, in the rear of its leading edge portion, is in the liquid in any one receptacle substantially the same length of time as every other part.

It is a further object of the invention to provide a method and apparatus for processing a continuous elongated strip of flexible material through liquids in which the leading edge portion of said strip is moved across, preferably over, a plurality of receptacles respectively containing the said liquids in a determined period of time and the portion of the strip in the rear of said portion is progressed and submerged in the liquids in the various receptacles at a much greater speed whereby a determined length of said strip accumulates in the liquids in each receptacle and is removed therefrom and the period the strip is in the liquid in a receptacle can be determined.

It is also an object of the invention to provide a method and apparatus for treating a continuous elongated strip of flexible material through a liquid in which the leading edge portion of said strip is moved across, and preferably over a receptacle containing said liquid in a determined period of time and in which the portion of said

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strip in the rear of said portion is progressed at a greater speed and is submerged in said liquid and said strip is progressively removed from said liquid at a determined speed whereby the time any portion of said strip is in said liquid can be determined.

It is still another object of the invention to provide a method and apparatus for treating a strip of exposed photographic print paper in which the said strip is progressed and submerged in the liquid in said receptacle at a certain speed and the leading edge portion of said strip is moved across said receptacle and the period of travel thereof across said receptacle controlled and said strip is progressively removed from said liquid at the first mentioned speed whereby the time that the strip is in said liquid may be determined.

It is also an object of the invention to provide an apparatus for processing an elongated continuous strip of photographic print paper comprising a plurality of receptacles containing the various print treating solutions, means adjacent the front end of each of said receptacles for progressively advancing the portion of said strip in the rear of its leading edge portion at a determined speed and submerging it in the solution of its respective receptacle and means extending along all of said receptacles for advancing the leading end of said strip at a slower determined speed, said strip being progressively removed from the solution in each receptacle at said first mentioned speed and preferably by said first mentioned means in the next adjacent receptacle.

It is further an object of the invention to provide an apparatus such as set forth in the preceding paragraph in which the position of one or more of said first mentioned means relative to its receptacle may be varied and in which the speed at which said leading end of said strip is advanced may also be varied.

It is still another object of the invention to provide an apparatus for treating an elongated continuous strip of flexible material in a liquid comprising a receptacle containing said liquid, means adjacent one end of said receptacle for progressively advancing said strip, and particularly the portion thereof a short distance from the leading end of said strip at a determined speed, means for directing said strip downwardly into the liquid in said receptacle, means for moving the leading end of said strip across said receptacle and controlling the period of time in which it travels lengthwise across said receptacle

and means for removing said strip from said liquid at said first mentioned speed.

It is also an object of this invention to provide a machine for processing a strip of flexible material through one or more liquids, comprising one or more receptacles for containing a liquid or liquids respectively together with means for moving the leading end of said strip across said receptacle or receptacles above the liquid therein so that said end is not submerged in said liquid and means for progressively moving the portion of said strip in the rear of said leading end and submerging said portion in the liquid in said receptacle or receptacles and progressively removing said strip from said liquid or liquids, said strip being moved without any leading strip or elongated member for moving it through said machine.

It is further an object of the invention to provide a machine for processing a strip through one or more liquids comprising a receptacle or receptacles for containing a liquid or liquids respectively, means for moving a strip through said liquid or liquids in a determined period of time, which machine can be kept running while successive strips are entered therein and moved therethrough, and which can also be kept running with no strip therein and without agitation of the liquids in said receptacle or receptacles.

These and other objects and advantages of the invention will be fully set forth in the following description made in connection with the accompanying drawings in which like reference characters refer to similar parts throughout the several views and in which:

Fig. 1 is a view in side elevation of the apparatus used certain parts being broken away and other parts shown in vertical section;

Fig. 2 is a partial view in side elevation some parts being broken away and others shown in vertical section;

Fig. 3 is a vertical section taken on line 3—3 of Fig. 2 as indicated by the arrows;

Fig. 4 is a partial horizontal section taken on line 4—4 of Fig. 2 as indicated by the arrows, Figs. 2 to 4 inclusive being shown on an enlarged scale;

Fig. 5 is a longitudinal vertical section through the machine taken substantially on line 5—5 of Fig. 6;

Fig. 6 is a partial plan view of the front end of the machine;

Fig. 7 is a vertical section taken substantially on line 7—7 of Fig. 6 as indicated by the arrow;

Fig. 8 is a partial vertical section taken substantially on line 8—8 of Fig. 6 as indicated by the arrow;

Fig. 9 is a view similar to Fig. 8 showing the parts in different positions;

Fig. 10 is a partial view similar to Fig. 8 showing the parts in another position;

Fig. 11 is a partial view similar to Fig. 8 showing the parts in still another position;

Fig. 12 is a vertical section taken substantially on line 12—12 of Fig. 11 as indicated by the arrow;

Fig. 13 is a partial vertical section taken substantially on line 13—13 of Fig. 7 some parts being omitted;

Fig. 14 is a partial plan view of the rear end of the machine;

Fig. 15 is a partial view in side elevation of the rear end of the machine;

Fig. 16 is a partial view in side elevation showing the mounting for the roller shaft bearings and

Fig. 17 is a vertical section taken substantially on line 17—17 of Fig. 6 as indicated by the arrow,

certain parts being broken away and others omitted.

Referring to the drawings a machine is shown comprising a frame designated generally as 20 which is supported upon spaced rear legs 21 and laterally and longitudinally spaced front legs 22. While frame 20 could be variously made in the embodiment of the invention illustrated, it is shown as comprising a pair of similar oppositely disposed angle members 20a made of sheet material such as sheet steel. Members 20a are supported at their rear ends on a transversely extending angle 23. Said members 20a are supported at their front ends on a bracket 25 formed of a plate having vertical side portions 25a which extend some distance along the outer sides of members 20a and are welded thereto. Bracket 20a has a horiontal bottom plate or portion 25b which rests on the top of a pair of angle members 24 which extend transversely between front legs 22 and have their top flanges engaging the top of said legs. Angle members 20a have secured to their inner sides adjacent the tops thereof in any suitable manner, as by welding angle brackets 26, said brackets having respectively inwardly extending horizontal portions 26a. An endless chain 27 has its upper run resting on portion 26a and is adapted to travel on said portion. Brackets 26 as shown in Fig. 5 are quite elongated and have downwardly extending front end portions 26c. Chains 27 adjacent portions 26c run over driving sprockets 28 secured to a shaft 29 extending transversely of the machine. Shaft 29 is secured adjacent its ends in bearings 30. One bearing 30 is secured by headed and nutted bolts 31 to the vertical flange of a bracket 33, having a horizontal flange engaging the bottom of angle 20a and secured thereto in any suitable manner as by welding. The other bearing 30 is secured by headed and nutted bolts 34 to the vertical flange on a bracket 35 also having a horizontal flange engaging the bottom of one member 20a and secured thereto in any suitable manner as by welding. Shaft 29 also has secured thereto adjacent one bearing 30 a ratchet wheel 36. Ratchet wheel 36 is rotated intermittently or step by step by a pawl 38 having a hub carried on an eccentric secured to a shaft 40. The spring 37 is secured to bearing 41 by one of the bolts 42 and extends over the top of pawl 38 to exert downward pressure thereon for holding it in engagement with ratchet wheel 36. Shaft 40 is journalled at one end in a bearing 41 secured by headed and nutted bolts 42 to the vertical flange of bracket 35. Said shaft is also journalled in a bearing 44a in a bracket 44. Bracket 44 is secured by headed and nutted bolts 45 to one side of a bracket 47 having a bottom flange resting upon portion 25a and secured thereto in any suitable manner as by welding. Adjacent bearing 44a shaft 40 has secured thereto a worm wheel gear 50 and a collar 51 is secured to the end of shaft 40 at the outer side of worm wheel gear 50. Worm wheel gear 50 is driven by worm gear 51 secured to a shaft 52 journalled in bearings 44b on bracket 44. A pulley 53 is secured to one end of shaft 52 over which runs a belt 54 also running over a pulley 55 secured to the driving or armature shaft of a motor 56 secured in any suitable manner to one side of bracket 25. Members 20a also have secured to their inner sides in any suitable manner as by welding adjacent their bottom flanges angle brackets 60. Brackets 60 have inwardly extending horizontal portions 60a on which the lower runs of chains 27 move. An angle member 59 is secured to the

top of the bottom flange of angle member **20***a* and has its vertical flange spaced somewhat from the inner vertical portion of bracket **60** to form a guide means for chain **27**. Brackets **60** as shown in Fig. 5 are quite elongated. Chains **27** at their rear ends run over sprockets **61** carried on stub shafts **62** secured respectively to vertical plates **63** which are longitudinally slidable in brackets **64** and **65** respectively having spaced plate **64***a* and **65***a* between which plates **63** are disposed. Plates **63** have secured to their end portions and projecting inwardly therefrom pins **64***b* and **65***b* respectively embraced by a coil or eyelet forming one end of a tensile coiled spring **66** the other end of which is secured in a hook bolt **67** extending through apertures in plates **64***c* and **65***c* forming parts of brackets **64** and **65**. Bolt **67** has a threaded end on which is received a thumb nut **68** engaging the outer sides of plate **64***c* and **65***c* respectively. It will be seen that each plate **63** is pulled rearwardly under tension of spring **66** to place tension upon sprockets **61** and the chains **27** respectively. This tension can be adjusted by rotation of thumb nut **68**.

Member **20***a* at one side of the machine has secured to its bottom flange a channel member **70**. An endless chain **72** has its lower run resting on and adapted to travel on the bottom of channel **70** within said channel. Said member **20***a* also has secured to its inner side some distance above its bottom several angle brackets **73**. While brackets **73** could be secured in any suitable manner, they are shown as secured to the vertical flange of member **20***a* by rivets **74**. A channel member **75** is supported upon brackets **73** and the upper run of chain **72** is disposed in and travels in channel member **75** resting upon the bottom thereof. Channel members **70** and **75** are of considerable length as shown in Fig. 5. Chain **72** at its front end runs over a driving sprocket **77** which is secured to shaft **40**. Chain **72** at its rear end runs over a sprocket **78** secured to a stub shaft **79** rigidly secured to and extending transversely from a plate **80**. Plate **80** is slidable between plates **65***d* forming part of bracket **65**. Plate **80** has secured thereto and projecting therefrom a pin **81** embraced by a coil or eyelet forming one end of tension coiled spring **82**, the other end of which is secured to a hook bolt **83** extending through an aperture in a plate **65***e* forming part of bracket **65**. Bolt **83** is threaded at its end and receives thereon a thumb nut **85** engaging the outer side of plate **65***e*. It will thus be seen that sprocket **78** is under tensile coil spring **82** to place tension upon chain **72**. This tension can be varied by rotation of thumb nut **85**.

The vertical sides of members **20***a* have formed therein at spaced points therealong in horizontal alignment openings **20***b* and brackets **90** have lower bearing portions **90***a* extending through said opening. Brackets **90** also have portions extending over the tops of members **20***a* and said brackets are secured to members **20***a* by headed and nutted bolts **91**, which bolts as shown in Fig. **6** preferably extend through slots **20***c* in members **20***a* to provide for positioning brackets **90** at different points longitudinally of members **20***a*. The bearing portion **90***a* as shown in Fig. 5 has an open-ended slot **90***b* therein with semi-cylindrical bottom and said bearing support. The ends of shafts **92** have enlarged central portions on which are secured resilient sleeves **93** made of rubber or similar material. The central portion of sleeve **93** is crowned or made of increased

diameter. While this could be variously done, in the embodiment of the invention illustrated and in practice, shaft **92** is provided with an annular groove **92***a* in which is disposed a circular or annular member **94** formed of a small rod or wire. Shafts **92** have secured at one end sprockets **96**. These sprockets are above and in line with the upper run of chain **72** and are rotated by said chain in its travel. The upper bearing portions of brackets **90** also have open-ended slots **90***c* with semi-cylindrical bottoms, which slots receive the ends of shafts **97**, having enlarged central portions on which are disposed resilient sleeves **98** made of rubber or similar material. Sleeves **93** and **98** form rollers and the upper rollers **98** rest on the lower rollers **93** with the ends of shafts **97** disposed somewhat above the bottoms of slots **90***c*.

The machine is designed to handle a strip of photographic print paper which will usually be in the form of a roll. This roll can be supported at the front end of the machine preferably on a spool carried on a shaft **100**, having reduced ends **100***a* which can be easily and conveniently disposed in bearing slots **101***a* formed in plates **101** secured to the outer sides of the vertical portions of members **20***a* at their forward ends and projecting therefrom. A cover plate **102** is provided which has a bottom portion disposed under the horizontal flanges of members **20***a* at their forward ends and a vertical portion **102***a* from which extends a rearwardly curved portion **102***b* which extends to a point substantially over shaft **40** and adjacent the forward rollers **93** and **98**. A front plate **99** extends across the front of the machine from the bottom of angle members **20***a* down to front angle members **24** to the front flanges of which it is secured in any suitable manner as by welding. Preferably the leading end of the strip **104** to be processed will have a member of some kind secured thereto. While various members might be used and the strip secured thereto in various ways in the embodiment of the invention illustrated, a member **105** is shown in the form of a flat bar having extending therethrough parallel narrow slots **105***a*. The end portion of strip **104** extends downwardly through the forward slot and upwardly through the rearward slot a short distance. The leading end of strip **104** is thus quite securely fastened to bar **105**. Bar **105** has rearwardly projecting extensions **105***b* for a purpose to be later described.

The bar or member **105** is moved logintudinally of the machine by upwardly projecting members or clips **27***a* secured to the inner sides of chains **27** at suitable spaced intervals. As shown in Fig. 7 members **27***a* can conveniently be formed as part of the links of chain **27**.

The strip of photographic print paper to be processed must be disposed in the various solutions which are used for processing such photographic print paper. Disposed within the sides of the members **20***a* are a plurality of receptacles **110**, **111**, **112** and **113** respectively. Receptacles **110**, **111** and **112** are shown as contained in a larger receptacle **115** and as being spaced from the front and rear and side walls thereof as shown in Figs. 1 and 4. Receptacle **112** has a partition **112***a* extending transversely thereof substantially at its longitudinal midpoint, which partition is flush with top of said receptacle but is spaced a short distance from the bottom thereof. Receptacle **113** has a similar partition **113***a* spaced from the bottom thereof and also has another partition **113***b* extending from the bottom thereof transversely

to a line spaced some distance from the top of said receptacle. Partitions 113a and 13b divide receptacle 13 into substantially equal compartments. Receptacle 110 will ordinarily contain a developing solution. Receptacle 111 will usually contain a short-stop solution. Receptacle 112 will contain a fixing solution and receptacle 113 will contain water or washing liquid. Temperature regulating water will preferably be circulated in receptacle 115 around receptacle 110, 111 and 112. This water may be used from that in receptacle 113 and for this purpose said receptacle has an opening 113c in one side thereof adjacent its top. An overflow member 116 is secured to the inner side of receptacle 113 having an opening aligning with opening 113c and having an open end a short distance below the top of receptacle 113. Another member 117 is secured to the outer side of receptacle 113 and has an opening aligning with opening 113c. Members 116 and 117 are shown as secured to receptacle 113 by the screws 118. Gaskets not shown may be used between members 116 and 117 and the sides of receptacle 113. Member 117 extends forwardly along the side of receptacle 112 and has a discharge opening 117a disposed over the side of receptacle 115. It will be noted that receptacle 115 is of less height than receptacles 110, 111 and 112 therein. An inlet pipe 119 is shown extending into the rear and top of receptacle 113 and an outlet pipe 114 is shown leading from the forward end of receptacle 115 adjacent its top.

The tops of receptacles 110, 111, 112 and 113 are disposed a short distance below lower roller 93 and the front sides of said receptacles and compartments thereof are respectively disposed substantially below the axis of lower rollers 93. In the operation of the machine the leading end of strip 104 and bar 105 pass between rollers 98 and 93 and it is desired to direct the portion of the strip in the rear of this leading end downwardly into the solution in said various receptacles. A lever 120 is provided which extends across the machine and has downwardly extending arms 120a swingingly mounted on pivot members 121 secured to the outer sides of angle members 20a. Lever 120 has projecting forwardly therefrom spaced arms 120b between which extend a small roller 122, having trunnions at its ends journalled for free rotation in arms 120b. Lever 120 also has projecting forwardly therefrom spaced arms 120c formed as shown in Figs. 8 to 11 inclusive, said arms having upwardly extending forward portions 120d adapted to be cammed or moved by the front edge or portion of bar 105 since lever 120 has sufficient weight so that it will drop to its lowest position as shown in Fig. 11 if unrestrained. There is a tendency for the strip to follow around the lower roller 93 and wind about said roller and to prevent this a small rod 124 extends between angle members 20a adjacent the lower roller 93 and somewhat below the axis thereof. A short distance in the rear of each roller 98 a plate 126 is disposed at each side of the machine and has a portion secured to the outer side of angle member 20a and portion extending across the top of said angle member and a vertical portion extending downwardly a short distance inside of said angle member. The ends of bar 105 are supported upon and move along on the top horizontal portion and inwardly extending flanges 26b of bracket 26. Adjacent each of the rollers 93 and a short distance in front of the same an upwardly inclined portion 26c is provided. A drying apparatus 120 is shown in Fig. 1 adjacent the rear end of the machine.

In carrying out the method of the invention and in the operation of the machine motor 56 will be driven and shaft 52 will be driven through belt 54, thus rotating worm wheel gear 51 and worm wheel gear 50. Shaft 40 will thus be driven as will the drive sprocket 77 and chain 72 will be driven and caused to travel over its sprockets 77 and 78. Said chain 72 in its travel engages the sprockets 96 secured to shaft 92 and rollers 93 which are disposed adjacent the front end of receptacles 110, 111 and the compartments of receptacles 112 and 113 will be driven. Eccentric 39 will be driven and the end of pawl 38 will be given a reciprocating or oscillating motion over ratchet wheel 36 so that at each revolution of shaft 40 said pawl will engage a tooth of ratchet wheel 36 and rotate said ratchet wheel for a portion of the revolution. Shaft 29 will thus be intermittently driven and sprockets 28 will be similarly rotated so that chains 27 will be caused to travel over their sprockets 28 and 61. Chains 27 travel as indicated by the arrow in Fig. 5 so that the top runs thereof move toward the rear end of the machine. The projections 27a move along close to portions 26b of bracket 26 as shown in Fig. 12 so as to engage the rear side of bar 105. As above described the chains 27 and 72 are kept under proper tension by the springs 66 and 82. The operator takes the strip of material which may be a roll of photographic sensitized material and places it upon shaft 100 which is then placed in the slots 101a or brackets 101. Bar 105 is secured to the leading end of the strip 104 by passing it through slots 105a as shown in Figs. 6 and 7. The operator then moves bar 105 forwardly on top plate 102b from which it passes on to portions 26b. When bar 105 passes on to portions 26b it is in position to be engaged by projections 27a. It will be moved by said projections as shown in Fig. 8 until it is engaged by rollers 93 and 98. A strip, such as a short strip, need not be in a roll but could be placed on the machine to be moved by its bar 105 as described. As described lower roller 93 is positively driven and upper roller 98 moves by friction against lower roller 93 or against the strip 104. After bar 105 is moved into engagement with the rollers as shown in Fig. 8 it is gripped and progressed forwardly, the upper roller 98 lifting to permit its passage. As soon as bar 105 passes the rollers 93 and 98 the upper roller drops down and engages the top of the strip 104. Said strip is thus engaged between the rollers and is progressed by the rotation of lower roller 93. As bar 105 approaches said rollers it engages the underside of portions or arms 120d of lever 120, lifting the same and thus lifting or raising lever 120 so as to bring roller 122 to sufficient height to permit bar 105 to pass thereunder. When said bar passes roller 122 said roller is disposed above strip 104 and lever 120 immediately drops so that roller 122 moves to the position shown in Fig. 11. It will be noted that roller 122 can drop down between projections 105b. After the portion of the strip in the rear of bar 105 is progressed by rollers 93 and 98 it is caused to move downward around lower roller 93 by roller 122 and said strip passes vertically downward into the solution in receptacle 110. Rollers 93 and 98 are rotated to progress the strip at a much greater speed than the speed of travel of chains 27. The strip is kept disposed substantially centrally of the

rollers by the crowned shape of the lower roller. If the strip tends to move to one side it will return to central position by the action of the said crowned portion. When bar **105** passes between said rollers it is given some momentum and passes quite a little distance beyond said rollers so that it moves ahead of its propelling portions **27***a*. To prevent the bar lifting at such time the members **126** are provided, the inner lower ends of which are disposed over the bar. The projections **105***b* will be acted on by rollers **93** and **98** and the bar will be rapidly moved forward as long as these projections are engaged by the rollers This gives some space between said bar and the rollers **93** and **98** between which it is passed, thus giving good room for strip **104** in its downward movement. As rollers **93** and **98** continue to revolve they feed the strip progressively downwardly into the solution in the receptacle so that quite a length of strip accumulates in the solution. This length of strip is usually disposed in folds and it is thus acted upon by the respective solution. Bar **105** may be moved by contact with chains **27** between the projections **27***a*. If it should thus be moved into engagement with the next rollers and only have a light frictional impulse of the chain, it would vibrate or chatter against the rollers. To prevent this the inclined portions **26***c* are provided. Said portions furnish sufficient obstruction to halt the movement of bar **105** by chains **27** should this occur and it will be held at said inclined portions **26***c* until the next projection **27***a*, which moved it between the rollers, reaches it and again positively moves it along on portions **26***b*. Bar **105** will thus be moved between the next pair of rollers **98** and **93** and will move as it did after passing between the first pair of rollers. After passing the first pair of rollers **98** and **93** the strip of paper has become thoroughly wetted and is now limp so that it has no tendency to project forwardly and not be submerged. After passing through the second set of rollers and the subsequent rollers, the strip passes around lower roller **93** adhering thereto until it is separated by rod **124**. It then passes vertically downward into the solution. The wetted and limp strip does not require the lever **120** as does the dry rather stiff strip passing between the first pair of rollers. It will be seen that the speed of travel of chains **27** will determine how long the strip is in the solution. The speed of travel of lower roller **93** determines how much or what length of strip will be fed into the receptacle. It will be seen that all of the lower rollers **93** are driven at the same speed. The strip is removed from the solution in each receptacle by the pair of rollers adjacent the rear end of the receptacle and it is thus progressively removed from the solution at the same speed that it was progressively moved into the solution. Any part of the wetted strip therefore is in the solution the same length of time as any other part. As stated the length of time the strip is in the solution is determined by the period of time that it takes bar **105** to move lengthwise across the receptacle. This period could be varied by having receptacles of different lengths and it could also be varied by moving a pair of rollers **93** and **98** by adjustment of bearings **90** lengthwise of the machine. If the rollers are moved farther rearwardly the strip of course would be in the receptacle a shorter length of time. In the present machine the speeds can be varied by varying the drive of ratchet wheel **36** by adjustment of eccentric **39** so that pawl **38** will pass over more than one tooth. The speed of motor **56** can of course be varied to change the speed of drive of both chains **27** and **72**. After the dimensions of the receptacles are determined the speed of the chains **27** and the speed of the progressing rollers will be suitably adjusted and determined. The bar **105** is thus moved by projections **27***a* on chains **27** until it passes through the last pair of rollers and it will then move onto a conveyor carrying it to some suitable point or apparatus such as the drying device **130**. Clean wash water will be furnished by inlet pipe **119** and this will pass into the rear compartment of receptacle **113**. This compartment will overflow over the partition **113***b* into the middle compartment. The water will pass under partition **113***a* and will overflow into member **116**. This water which will be usually fairly cool will pass through member **117** and be delivered through opening **117***a* into the top of and into the rear end of receptacle **115**. This liquid will flow out at the front of receptacle **115** through discharge outlet **114** and will be conducted to some suitable point as to a sewer. Receptacle **110** will ordinarily contain the developing solution. Receptacle **111** will contain a short-stop solution. The fixing solution or fixing bath for the print will be contained in receptacle **112** while the wash water or liquid will be contained in receptacle **113**. As above described the strip is progressively moved through these receptacles in the order above given. The strip is thus completely processed after passing through the various receptacles. It will be noted that the most nearly washed part of the strip will pass through the freshest water.

From the above description it will be seen that we have provided a very efficient method and apparatus for processing a continuous strip of photographic print paper. The strip is handled automatically by the machine and the time that it is in the solution in each receptacle is definitely controlled. As stated the strip can be delivered to some suitable or desirable apparatus such as a drying device and the strip then be moved to a cutter where the individual pictures thereon would be separated. The machine will have a high degree of utility in the making of photo Christmas cards, "identograph" photo strips, photo postcards, "Teacher's Agency" photos or pictures, aerial mapping strips, school portrait photos, micro film letters as used for the armed forces overseas, continuous commercial photo finishing, many commercial photos, photostat prints and small blue prints. By the use of the method and apparatus the printing operation can be greatly expedited and the expense thereof greatly reduced. It is often desired to make quantity runs of a single negative. When this is done the printing or exposure time can be set and the printing automatically or mechanically duplicated. To do such printing on a continuous strip will be highly efficient. The machine can handle various widths of the strips processed.

It will be noted that the top rollers **98** can be removed by merely lifting them and shaft **97** from slots **90***c* in bearings **90**. The lower rollers **93** can also be lifted from the slots **90***b* as the chain **27** will flex sufficiently to permit this. Said rollers **93** can then be turned so as to be lifted from the machine. It is desirable to have these rollers readily removable so that they may be cleaned at desired intervals. The various rollers **93** are interchangeable as are also rollers **98** which is very desirable. It is also pointed out that there is a wringing or squeegee action of the

rollers which removes most of the liquid from the strip as it passes between the rollers. This liquid drains back into the tank or receptacle from which the strip is being removed.

One important feature of the machine is that it can be run continuously and does not have to be stopped for each strip that is entered therein. The machine will handle strips of any length and these are merely entered in the machine by the operator after which they are automatically moved through the machine including the receptacles and liquids. The length of the strip as stated may vary and it will be successively processed whether it is two feet, four feet or fifty feet in length.

It is thus not necessary to stop the machine after a strip has been processed. There is no chance for any overrunning of the machine and it can be kept in operation while no strip is being processed. During such time there is no agitation of the liquids causing excessive oxidation. The machine needs very little attention and after the strip is entered therein as above stated, the machine operates automatically. The operator doing the printing could give the necessary attention to the machine. The machine is quite compact, thus taking up comparatively small space and all parts of the machine are quite accessible.

It is pointed out that the strip is the present method and apparatus is moved through the machine without the necessity of any leading strip or elongated or other member which must move through the machine with the strip and be threaded through the machine. It is only necessary to have the small member secured in the leading edge of the strip and this may be in the form of a small rod or just a flat narrow bar as illustrated.

As stated while the method and apparatus have been described specifically in connection with processing a sensitized strip of photographic material, it is obvious that the method and apparatus are applicable to the processing of strips of many kinds of material which are to be processed through one or more liquids. Thus the strip could be passed through various liquids for being coated with different materials. It might be desirabe to pass a strip of certain material through various liquids to develop or cure it by the action of certain chemicals or liquids. With the present developments in color photography the machine would have a high degree of utility in handling and processing colored films. The method and apparatus have been amply demonstrated in actual practice and found to be very successful and efficient.

It will of course, be understood that various changes may be made in the form, details, arrangement and proportions of the apparatus and in the steps and sequence of steps of the method without departing from the scope of applicant's invention, which generally stated, consists in a method and apparatus capable of carrying out the objects above set forth, such as disclosed and defined in the appended claims.

What is claimed is:

1. An apparatus for processing an elongated strip of flexible material through a liquid having in combination, a receptacle containing said liquid, means for moving the leading edge of said strip substantially directly across said receptacle, means for simultaneously advancing said strip in the rear of said edge at a much greater speed to cause said strip to form a loop or loops and be moved downwardly and submerged in the liquid in said receptacle and means for withdrawing said strip from said liquid in said receptacle at said greater speed.

2. An apparatus for processing an elongated strip of flexible material through a liquid having in combination, a receptacle containing said solution, means for moving the leading edge of said strip substantially directly across said receptacle so that it traverses the length of said receptacle in a certain period of time, means for simultaneously progressing the portion of said strip in the rear of said leading edge at a greater speed to form a loop or loops, means for directing said portion and said loop or loops downwardly into the liquid in said receptacle and means for progressively removing said strip from said liquid in said receptacle.

3. An apparatus for processing an elongated strip of flexible material through liquids having in combination, a plurality of receptacles respectively containing said liquids, means adjacent the front of each of said receptacles for advancing said strip in the rear of its leading edge portion at a determined speed to form a loop and directing said strip and loop into the liquid in its respective receptacle and means for moving and controlling the movement of the leading edge of said strip lengthwise of said receptacles in a line adjacent the tops thereof so that the submerged portion of said strip is in each receptacle for a determined period of time.

4. An apparatus for processing an elongated strip of flexible material through liquids having in combination, a plurality of receptacles containing respectively the different liquids, means adjacent one end of each receptacle for progressing said strip at a determined speed and for causing said strip to travel downwardly in the liquid in each of said receptacles, means for simultaneously moving the leading edge of said strip substantially directly across all of said receptacles at a slower speed, said strip being removed from one receptacle and the liquid therein by said first mentioned means at the next adjacent receptacle whereby it is disposed in each receptacle a determined period and means for removing said strip from the last receptacle.

5. An apparatus for processing an elongated strip of flexible material through liquids having in combination, a plurality of liquid containing receptacles, means for advancing the leading end of said strip at a determined speed substantially directly across each of said receptacles, means adjacent the front end of each of said receptacles for simultaneously, advancing the strip in the rear of said leading edge at a greater speed and for directing it downwardly in the liquid in said receptacle, said strip being removed from each receptacle by said last mentioned means in the next adjacent receptacle and means moving at said greater speed for removing said strip from the last of said receptacles whereby the speed of travel of said leading edge and said last mentioned speed will determine the time that said strip is in each of said receptacles.

6. An apparatus for processing an elongated strip of flexible material through liquids having in combination, a plurality of receptacles respectively containing said liquids, means adjacent the front end of each of said receptacles for feeding said strip at a determined speed and directing it downwardly into the liquid in its respective receptacle, said means acting to move the leading edge of said strip and means for moving

said leading edge across said receptacles at a much slower speed after it passes said first mentioned means whereby a determined length of said strip is accumulated in each of said receptacles.

7. The structure set forth in claim 6 said first mentioned means acting to remove said strip from the preceding receptacle and means for removing said strip from said last receptacle at said greater speed.

8. The structure set forth in claim 6 and means for temporarily halting the advance of said leading edge after it passes said first mentioned means.

9. An apparatus for processing an elongated strip of flexible material through a liquid having in combination, a receptacle containing said liquid, means for progressing said strip at a determined speed, said means acting to advance the leading edge of said strip therepast, means for retarding said leading edge, means moving at a determined and slower speed for positively moving said leading edge so that it moves across said receptacle in a determined period of time, means for causing said strip at the rear of said leading edge to be submerged in said liquid after it leaves said first mentioned means and means for withdrawing said strip from said liquid at said first mentioned speed.

10. An apparatus for processing an elongated strip of flexible material through a liquid having in combination, a receptacle containing said liquid, means for advancing the portion of said strip disposed a short distance in the rear of its leading edge at a determined speed and submerging said portion in said liquid, means for simultaneously progressing said leading edge across said receptacle adjacent the top thereof and controlling the period of travel of said leading edge of said strip across said receptacle and means for removing said strip from said liquid at said first mentioned determined speed whereby the time said strip is in said liquid can be determined.

11. The structure set forth in claim 10 and means for positioning said first mentioned means at different points along said receptacle to vary the point at which said strip enters said liquid and thereby the time that said strip is in said liquid.

12. An apparatus for processing an elongated strip of flexible material through a liquid having in combination, a receptacle containing said liquid, a pair of rollers adjacent one end of said receptacle, means for driving one of said rollers for progressing said strip between said rollers at a determined speed, means moving along adjacent the top of said receptacle for moving the leading edge of said strip across said receptacle in a determined period of time and means for removing said strip from said liquid and receptacle adjacent the rear end of said receptacle.

13. The structure set forth in claim 12 the lower of said rollers of each of said pair being crowned at its central portion to center said strip in its travel.

14. The structure set forth in claim 12 and means extending transversely of said receptacle along said lower roller below the proximate portion of said rollers for preventing said strip from winding about said lower roller.

15. An apparatus for processing an elongated strip of flexible material through a liquid having in combination, a receptacle containing said liquid, a pair of rollers at one end of said receptacle, means for rotating one of said rollers for frictionally engaging and progressing said strip between said rollers, a member connected to the leading end of said strip movable between said rollers, a second member disposed at the rear side of said rollers below their proximate portions for causing said strip to be submerged in said liquid, said second member being movable to permit passage of said first mentioned member therepast and means for so moving said second member.

16. An apparatus for processing an elongated strip of flexible material through liquids having in combination, a plurality of liquid-containing receptacles, a member secured to the leading end of said strip, means for moving said member at a determined speed lengthwise of said receptacles in a line substantially directly across the same, means adjacent the front of each of said receptacles for progressing the portion of said strip in the rear of said member at a greater speed and directing it downward into liquid in said each of said receptacles, said portion being removed from each of said receptacles by said last mentioned means at the next adjacent receptacle and means for removing said strip from the last receptacle.

17. The method of processing an exposed elongated continuous strip of material through a liquid which consists in progressing the leading end of said strip across a receptacle containing said liquid adjacent the top thereof in a determined period of time, simultaneously progressing the portion of said strip in the rear of said end at a much greater speed and submerging it in said liquid and withdrawing said strip from said liquid at said greater speed whereby each part of said portion of said strip is in said liquid substantially the same period of time.

18. The method of processing an elongated continuous strip of material through a liquid which consists in progressing the portion of said strip in the rear of its leading end and submerging it in said liquid in a receptacle, simultaneously moving said leading end across said receptacle and controlling the period of time in which it moves lengthwise across said receptacle and simultaneously progressively removing said portion from said liquid after a determined period of time.

19. The method of processing an elongated continuous strip of material through liquids which consists in moving the leading edge of said strip across successive receptacles containing said liquids adjacent the tops of said receptacles in determined periods of time respectively and simultaneously moving the strip in the rear of said leading edge at a much greater speed and submerging the same in the liquid in each of said receptacles and removing said strip from said liquid in each of said receptacles at said greater speed whereby a certain length of said strip accumulates in each receptacle and each part of said strip in the rear of said leading edge is disposed in the liquid in each of said receptacles for a certain definite period.

20. The method of processing a strip of flexible material through a liquid which consists in moving the leading end of said strip substantially directly across a receptacle containing said liquid in a determined period of time, simultaneously progressively moving the portion of said strip in the rear of said leading edge at a greater speed and submerging it in the liquid in said receptacle

and then simultaneously removing said portion progressively from said liquid.

21. An apparatus for processing an elongated strip of flexible material through a liquid having in combination, a receptacle adapted to contain said liquid, means adjacent the front end of said receptacle for advancing said strip, a member secured to the leading end of said strip, said means acting to advance said member and leading end and to then progressively advance the portion of said strip in the rear of said member and submerge said portion in said liquid, and additional means for simultaneously moving said member and leading end at a slower speed across said receptacle adjacent the top thereof.

22. The structure set forth in claim 21 and means for removing said portion of said strip from said liquid at substantially the same speed at which it was progressively advanced and submerged therein.

23. An apparatus for processing an elongated strip of flexible material through a liquid having in combination, a receptacle adapted to contain said liquid, a pair of rollers adjacent the front end of said receptacle, means for driving one of said rollers, a member secured to the leading end of said strip, means extending longitudinally of said receptacle on which said member is supported and can move and an endless means for moving said member lengthwise across said receptacle on said last mentioned means.

24. An apparatus for processing an elongated strip of flexible material through a liquid having in combination, a receptacle adapted to contain said liquid, a pair of rollers adjacent the front end of said receptacle, means for rotating one of said rollers, a member secured to the leading end of said strip, said member being constructed and arranged to pass between said rollers and be moved thereby to lead said strip therebetween, said rollers being constructed and arranged to grip said strip in the rear of said member and progressively advance the same and means for causing said strip to move downwardly into the liquid in said receptacle.

25. The structure set forth in claim 24 a second pair of rollers and means for rotating one of said rollers at the same speed at which said first mentioned rollers rotate to remove said strip from said liquid.

26. The structure set forth in claim 24 said last mentioned means comprising a member extending across said strip, a swinging means carrying said member having a portion constructed and arranged to be engaged by said first mentioned member as it approaches said rollers to lift said second mentioned member above said first mentioned member and strip.

27. An apparatus for processing an elongated strip of flexible material through a liquid having in combination, a receptacle adapted to contain said liquid, a pair of rollers adjacent the front end of said receptacle, means for rotating one of said rollers, a member secured to the leading end of said strip, said member being constructed and arranged to pass between said rollers and be moved thereby to lead said strip therebetween, said rollers being constructed and arranged to grip said strip in the rear of said member and progressively advance the same, a roller arranged to engage the top of said strip and cause the same to move downwardly into the liquid in said receptacle, a swinging member carrying said last mentioned roller and means engaged by said member as it approaches said roller for lifting said swinging member and last mentioned roller above said first mentioned member and strip to permit passage of the latter thereunder.

28. An apparatus for processing an elongated strip of flexible material through liquids having in combination, a plurality of receptacles adapted respectively to contain said liquids, a pair of rollers adjacent the front end of each of said receptacles, a sprocket secured to one roller of each of said pairs, an endless chain moving along said receptacles engaging said sprockets to rotate each pair of said rollers to advance said strip and an endless member connected to said leading end moving along all of said receptacles for moving the leading end of said strip.

29. An apparatus for processing an elongated strip of flexible material through liquids having in combination, a plurality of receptacles adapted respectively to contain said liquids, a pair of rollers adjacent the front end of each of said receptacles for advancing said strip therebetween, an endless member moving adjacent all of said rollers for rotating the same, a second endless member moving along all of said receptacles for moving the leading end of said strip and means for moving said second endless member at a much slower speed than said first mentioned endless member so that the peripheral speed of said rollers is much greater than the linear speed of said second endless member.

30. An apparatus for processing an elongated strip of flexible material through liquids having in combination, a plurality of receptacles adapted respectively to contain said liquids, a pair of rollers adjacent the front end of each of said receptacles, means for rotating one roller of each of said pairs for advancing said strip, means moving along all of said receptacles for advancing the leading end of said strip therealong, means adjacent certain of said pairs of rollers for impeding movement of said leading end and means movable by said second mentioned means for positively moving said leading end to the next pair of rollers.

31. An apparatus for processing an elongated strip of flexible material through a liquid having in combination, a receptacle adapted to contain said liquid, a pair of rollers adjacent the front end of said receptacle, means for rotating one of said rollers, a member secured to the leading end of said strip constructed and arranged to pass between said rollers and be advanced thereby and means adjacent said rollers at the rear thereof for guiding said member and preventing lifting thereof.

32. An apparatus for processing an elongated strip of flexible material through a liquid having in combination, a receptacle containing said liquid, means for moving the leading end of said strip across said receptacle adjacent the top thereof and in a determined period of time and means for progressively moving the portion of said strip in the rear of said leading edge at a greater speed and submerging it in said liquid and means for subsequently progressively removing said strip from said liquid at said greater speed.

33. An apparatus for processing an elongated strip of flexible material through liquids having in combination, a plurality of receptacles containing said liquids, means for moving the leading end of said strip across all of said receptacles adjacent the tops thereof respectively in deter-

mined periods of time and means for simultaneously progressing said strip in the rear of said leading end adjacent the front end of each of said receptacles at a higher speed of movement than the movement of said leading end, to form loops therein and submerge said strip in the liquid in each of said receptacles respectively, and means for removing said strip from the last of said receptacles whereby the speed of movement of said leading end determines the time of treatment in each of said receptacles.

34. An apparatus for processing an elongated strip of exposed photographic paper in liquids having in combination, a plurality of receptacles containing said liquids, movable means adjacent all of said receptacles for moving the front end of said strip substantially directly across said receptacles at a determined speed, a pair of rollers adjacent the front end of each of said receptacles, means for driving a roller of each of said pairs for simultaneously advancing said strip between said rollers respectively at a much greater speed, and means acting in cooperation with each pair of said rollers for submerging said strip in the liquid in its respective receptacle, said strip being removed from each receptacle by the pair of rollers adjacent the end of the next adjacent receptacle at said greater speed and means for removing said strip from the last receptacle at said greater speed.

35. The method of processing a strip of exposed photographic paper through a processing liquid in a receptacle which consists in moving the leading end of said strip in a line substantially directly across said receptacle at a substantially uniform determined speed whereby the time used in traversing said receptacle is determined, simultaneously moving the portion of said strip in the rear of said leading end at a much greater speed and submerging it in said liquid, and removing said strip from said liquid at said greater speed whereby the speed of movement of said leading end across said receptacle determines the time of processing and said greater speed determines the volume of strip processed.

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