Jan. 20, 1953 H. G. GOETZ ET AL 2,626,146

PRECISION STRIP FEED MECHANISM

Filed July 8, 1949

3 Sheets-Sheet 1

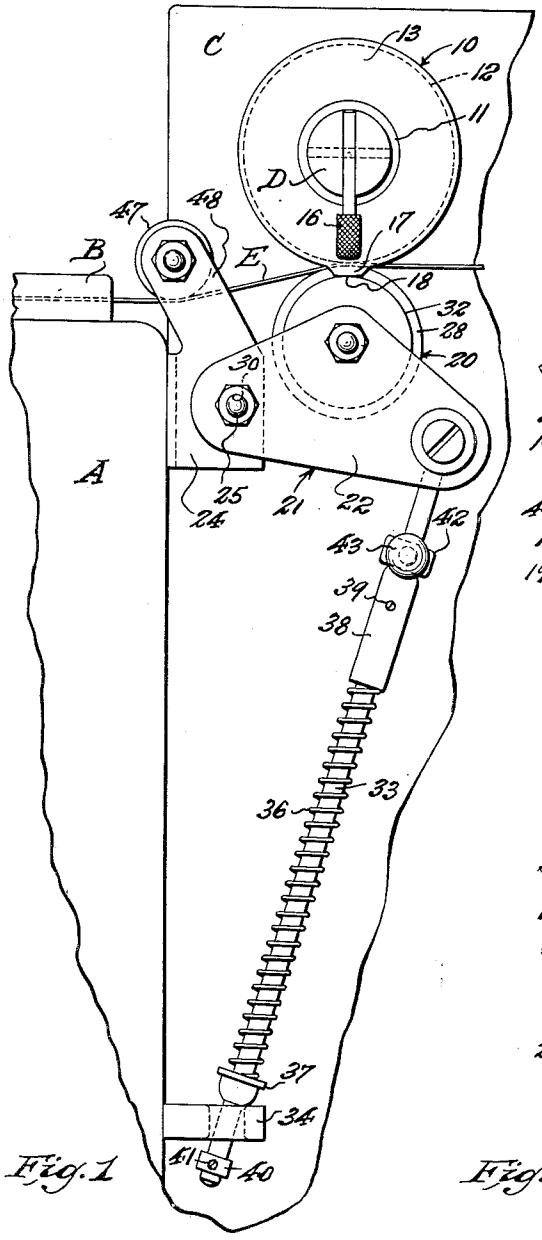


Fig. 1

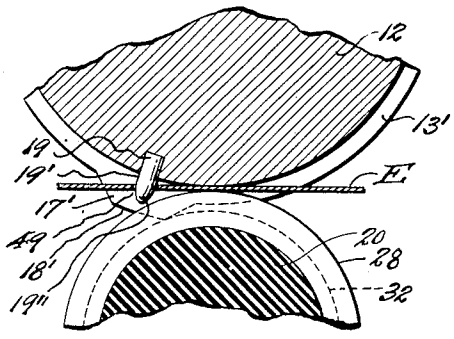


Fig. 3

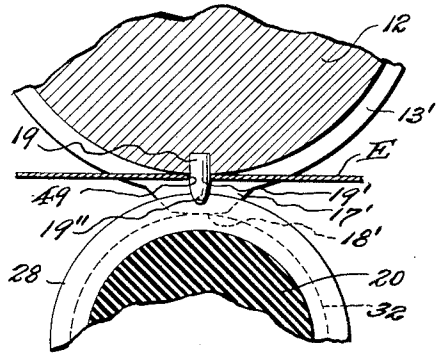


Fig. 4

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PRECISION STRIP FEED MECHANISM

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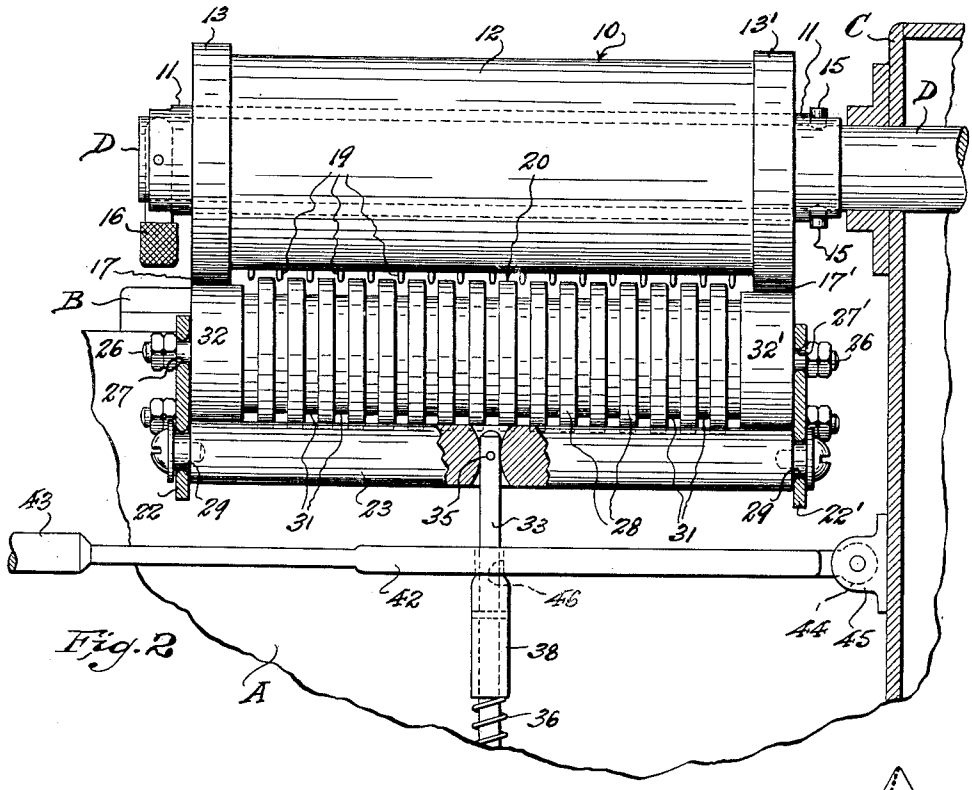


Fig. 2

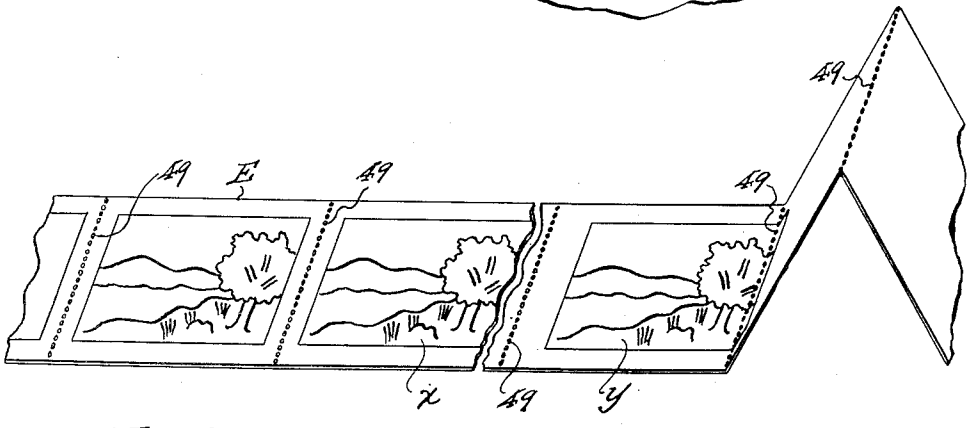


Fig. 5

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PRECISION STRIP FEED MECHANISM

Filed July 8, 1949 3 Sheets-Sheet 3

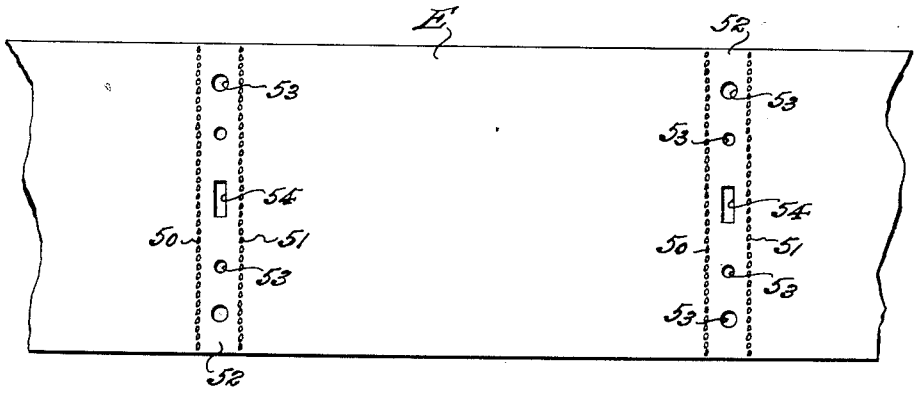


Fig. 6

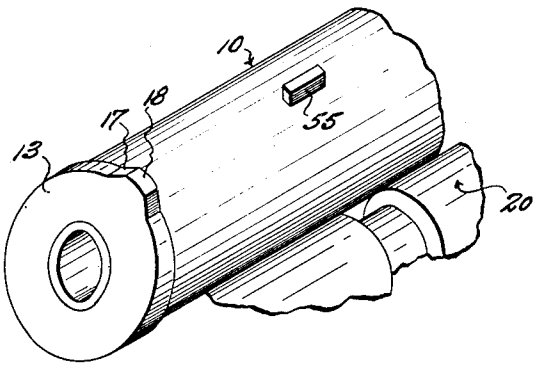


Fig. 7

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2,626,146

PRECISION STRIP FEED MECHANISM

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Application July 8, 1949, Serial No. 103,698

3 Claims. (Cl. 271—2.3)

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The invention relates, in general, to strip feed mechanism of the class adapted to feed a strip of sheet material intermittently through an operating station and to cause successive sections of the strip to stop at the operating station for a dwell period of sufficient duration for performance of some operation affecting each strip section.

An example of strip feed mechanism of this kind occurs in photographic printers of the type in which a sensitized paper strip is fed step-by-step through a printing station at which individual sections, or "frames," are caused to register in succession with a mask opening for exposure to printing light transmitted by a photographic negative.

In particular, the invention relates to the strip-engaging propulsion device that forms a constituent part of such a feed mechanism.

Since the invention actually was conceived as an adjunct to a strip feeder for photographic printers, it will be disclosed herein in its specific adaptation to that particular art.

In order to make the underlying purpose of the invention clear, the need for such a device and the steps followed in its development will be related.

In the printing of photographs in strip form, there are two general methods that may be followed. When the prints are to be used merely for viewing purposes, with possible selection of individual pictures for utilization in their original or enlarged size, it usually is practicable to print the successive pictures on a plain sensitized strip without regard to spacing or proportion. The other method, which was originated by us, is intended to produce pictures that are printed in artistically balanced proportion on precisely measured frames with the definite object in view of mounting the printed strip intact in accordion-folded condition in suitable envelopes or foldable wrappers, such as may be used for packaging and mailing purposes, or of binding the severed individual prints in booklet form. In either instance, the precise definition of the end margins of the frames, in accordance with our procedure, is accomplished by cutting intervening transverse rows of perforations in the paper strip prior to the printing process. Since the paper strip will have a sensitized emulsion face at this time, we run the strip through the perforating machines in a dark room.

When perforated strips of this kind are to be used in the printing process in accordance with our practice, it is essential to properly balanced,

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artistic printing that each print frame shall be caused to register precisely with the mask opening of the printer, particularly if subsequent paneling or embossing of the marginal portions of the frames is contemplated. In our feed mechanism for photographic printers that forms the subject of U. S. application Serial No. 54,052, now Patent No. 2,600,636, filed October 12, 1948, we have accomplished this precise registration by employment of a meter roller having sprocket teeth for engagement with perforations in the sensitized paper strip. Since the appearance of the prints would be unattractive if there were rows of perforations along their side edges, we could not use double sprocket wheels such as are used for propulsion of motion picture films through cameras and projectors. Instead, we found it expedient to use a meter roller that was twice as large in circumference as the length of a print frame and to provide this roller with two diametrically opposite axial rows of sprocket teeth for propulsive engagement with alternate rows of strip perforations. However, even with two rows of teeth on one roller, it was necessary to loop the strip around more than 180 degrees of the roller periphery in order to maintain constant engagement of one or the other row of sprocket teeth with strip perforations to avoid slippage. This looping requirement necessitated the use of two specially disposed guide rollers and increased the strip drag to a degree that called for extra power input and thereby lowered the efficiency of the machine. Despite these disadvantages of our earlier propulsion device, it was capable of such precision in its metered feeding action that every print frame was accurately registered with the mask opening of the printer.

It has been our primary object to eliminate the disadvantages of our earlier strip propulsion without sacrificing precise frame registration. In doing this, our efforts have been directed toward utilization of a pressure roller in cooperation with the meter roller, whereby the sensitized strip may pass between both rollers in a substantially straight line with only tangential contact with the rollers at the nip thereof. However, we were unable to rely entirely upon the gripping action of the two rollers for propulsion, because there would be no provision for proper registration of the print frames, as required. With that mode of propulsion, the day-to-day linear contraction and expansion of the paper strip caused by changes in atmospheric conditions, particularly relative humidity, would result in seriously unbalanced printing. For example, if contraction

or expansion should cause each frame to be only .001 inch out of alignment, a strip of 1000 frames will be a whole inch out. This discrepancy might not be noticeable in the first few prints of the series, but toward the trailing end of the strip the cumulative displacement of as little as half an inch might cause an important part of the subject, such as a person in a group picture, to be printed outside the border of the picture. That would destroy the value of the pictures affected.

After exhaustive experimentation, we solved the problem by using a single row of sprocket teeth on the meter roller for engagement with strip perforations at the nip of the meter roller and cooperating pressure roller, and also by providing means for releasing the pressure roller during the brief interval that the teeth will be either partially or completely engaged with the strip perforations in order to permit the strip to float momentarily and thereby be free for adjusted registration of its perforations with the sprocket teeth, which otherwise could not occur in the event that linear contraction or expansion of the strip has caused displacement of the perforations. Readjusted tooth and perforation registration serves the desired purpose of equalizing each print frame in relation to the mask opening of the printer. There will be no interruption in strip propulsion, because the sprocket teeth will substitute for the pressure roller in the interval of released pressure.

It is an object of the invention to provide a precision strip propulsion device that, while peculiarly suited for application to the photographic printing art, is also adapted for use in feeding strips of any kind through any sort of process wherein successive sections thereof must be equalized in position at an operating station to correct for dislocation caused by linear expansion or contraction or by other deformations in the physical characteristics of the strips that ordinarily cannot be avoided.

Another object is to provide a novel mounting means for the pressure roller that maintains uniform contact with the strip being fed between the same and the meter roller and yet is sufficiently yieldable to allow for imperfections or inequalities in thickness of the strip, including those inequalities that are unevenly distributed between the side edges as well as those that extend clear across. This feature likewise is capable of general application.

Further objects and advantages of the invention will become apparent as the following specific description is read in connection with the accompanying drawings, in which:

Fig. 1 is a fragmentary front elevation of a rapid-type photographic printer having the improved frame-equalizing strip propulsion device applied to its precision feed mechanism; and Fig. 2 is an elevation thereof viewed from the right in Fig. 1, shown in part section.

Fig. 3 is a cross sectional view on an enlarged scale of portions of the meter roller and pressure roller, showing the pressure roller in elevated strip engaging position at a time immediately preceding strip release.

Fig. 4 is a view similar to Fig. 3, showing a later stage when the pressure roller has been released and the strip is floating;

Fig. 5 is a perspective view of a portion of a photographic printing strip as perforated for accordion-folding showing the same after printing with examples of equalized and unbalanced pictures.

Fig. 6 is a fragmentary plan view of a modified form of perforate strip; and Fig. 7 is a fragmentary perspective of the meter and pressure rollers adapted for cooperation with the modified perforate strip of Fig. 6.

Referring in detail to the drawings, in which like reference characters indicate corresponding parts in the several views, the meter roller 10 is suitably driven, as e. g. by an intermittent driving transmission or feed mechanism of a rapid-type photographic strip printer disclosed in our aforesaid copending application Ser. No. 54,052, now Patent No. 2,600,636. It is to be understood, however, that we do not wish to be restricted to that specific application. The device is capable of use in connection with the feed mechanism of other machines that function in a similar manner, as previously explained. Any slight modification required for adaptation to a particular machine should be within the scope of the appended claims.

Considering the invention, therefore, as being applied to a photographic printer, particular reference will now be made to Figs. 1 to 4, inclusive, wherein character A designates the housing of a standard type of rapid printer having the usual apertured mask B in its top wall. The position of mask B will be referred to as the printing station, for it is in stationary registration with the mask opening that the sensitized emulsion face of each frame of a paper strip being processed is exposed to printing light generated within housing A and transmitted by a photographic negative. Annexed to housing A of the standard printer is the housing C containing the precision power transmission or feed mechanism as disclosed in our prior application Ser. No. 54,052, now Patent No. 2,600,636, and by which, in the instant case, meter roller 10 is driven. No changes in the structural details of the feed mechanism proper have been necessitated by adaptation to use of the new strip propulsion device, so the only element of that mechanism to be shown in the drawings is driven shaft D that protrudes from the front wall of housing C in a position adjacent to and slightly elevated above the level of printing station represented by mask B.

It should be sufficient to state concerning the feed mechanism contained in housing C that it causes shaft D to turn one revolution counterclockwise (Fig. 1) following each printing exposure under actuating control of the printer operator.

The new strip propulsion device includes a positively driven feed or meter roller 10 that comprises a tubular core 11 adapted to fit slidably on shaft D, a cylindrical body 12, and end plates 13, 13' of generally circular form. Core 11 has notches 14 in its inner end for engagement with a cross-pin 15 carried by shaft D, whereby roller 10 is secured to said shaft. A latch 16 of suitable construction is provided at the outer end of shaft D to releasably secure roller 10 on shaft D. Body 12 of roller 10 may be made of any material that will afford the desired traction in its contact with a sensitized print strip, indicated at E. End plates 13, 13' are slightly larger in diameter than body 12 and are provided with peripheral cam nosings 17, 17'. The cam nosings 17, 17', respectively, have outer dwell surfaces 18, 18' whose function will be described more fully later.

Meter roller 10 is shown in Fig. 2 as being provided on its periphery with a longitudinal row of evenly spaced sprocket teeth 19 for propulsive engagement with suitable perforations in strip E. Teeth 19 preferably have root portions 19' of uniform diameter and tapered points 19'' (see Figs. 3 and 4). The location of teeth 19 is substantially in an axial plane bisecting cam nosings 17, 17' and the length of the teeth is such that they terminate inward of dwell surfaces 18, 18'.

An idle pressure feed roller 20 for cooperation with meter roller 10 in the propulsion of strip E is journaled directly beneath said meter roller in a supporting frame 21 composed of side plates 22, 22', and a spacer rod 23. Frame 21 in turn is supported by a bracket 24 detachably mounted on printer housing A. In order that frame 21 may rock up and down and thus permit pressure roller 20 to separate from the meter roller 10, the left side portions (Fig. 1) of plates 22, 22' are pivotally connected to bracket 24 by suitable means, such as bolt 25.

Pressure roller 20 is preferably of resilient material, such as rubber, and in its present embodiment is rotatably mounted on a shaft 26 whose ends protrude, respectively, through aligned holes 27, 27' in the upper central portions of frame plates 22, 22'. It being desirable that pressure roller 20 shall be free for longitudinal rocking or wobbling movement in its support to permit accommodation of its peripheral bearing surface 28 to inequalities in thickness of strip E, holes 27, 27' preferably are of the centrally constricted, flaring mouth structure shown in Fig. 2. As shown, holes 29 for spacer rod 23 and holes 30 for pivot bolt 25 are of the same form as said holes 27, 27' for the same purpose.

Pressure roller 20 is urged upwardly toward meter roller 10 by spring means which will be described presently. The periphery 28 of roller 20 is adapted to bear against the periphery of meter roller 10 when there is no photographic print strip E being processed, or to press a strip that may be undergoing processing against the said meter roller with such force that it will be gripped between the two cooperating rollers and propelled lengthwise as the meter roller turns. Since the sprocket teeth 19 of roller 10 project through perforations in strip E, clearance for these teeth must be provided in pressure roller 20. This has been done by providing a plurality of annular grooves 31 in the periphery of roller 20. These grooves are spaced and positioned to register with the respective teeth 19.

The ends of pressure roller 20 are fitted with follower rings 32, 32', for respective operative contact with cam nosings 17, 17' when the latter are passing through an arc bisected by the dead-center plane of both rollers axes, as shown in Figs. 1, 2, 3 and 4. The outside diameter of follower rings 32, 32' is such that, when they are in contact with the dwell surfaces 18, 18' of cam nosings 17, 17', pressure roller 20 will be in its depressed position wherein it is released from pressure contact with meter roller 10 or an intervening strip E. When free from contact with the cam nosings 17, 17', follower rings 32, 32' will not contact end plates 13, 13' of meter roller 10 and therefore will not interfere with firm gripping engagement of pressure roller 20 and meter roller 10 with strip E.

It has been found convenient to resiliently urge pressure roller 20 in operative rolling contact with a strip E by use of the specific spring urging means disclosed in Figs. 1 and 2, but other

means for the performance of this function may be utilized within the scope of the invention. We especially prefer the illustrated means because of its simplicity and effectiveness. In this embodiment, a substantially vertical thrust rod 33 has its lower end slidably mounted in an anchor block 34 affixed in suitable manner to printer housing A. The upper end of thrust rod 33 is pivotally connected to the center of spacer rod 23 of roller frame 21, as at 35, in a manner similar to that in which the ends of said rod 23 are rockingly engaged with side plates 22, 22' of said frame 21. A spiral compression spring 36 surrounding thrust rod 33 is interposed between washer 37, resting on anchor block 34, and an adjustable sleeve 38 that is fitted on rod 33 near its upper end and is secured thereon in longitudinally adjusted position by suitable means, such as setscrew 39. Spring 36 tends to elevate frame 21 and thereby yieldably maintain pressure roller 20 in its uppermost operative position. The degree of resilient pressure may be regulated by adjustment of sleeve 38 on rod 33. Due to the way in which the upper end of thrust rod 33 is connected with spacer rod 23, frame 21 and pressure roller 30 are free to rock or wobble in the desired functional manner for the above stated purposes. A retaining or stop collar 40 is applied to the extreme lower end of thrust rod 33 below anchor block 34 for contact with said anchor block and is secured on rod 33 by suitable means, such as setscrew 41.

It is often necessary to manually depress pressure collar 20 from its operative relation to meter roller 10, particularly when threading a fresh strip E into the printer and propulsion device. In order to facilitate such manipulation, a release lever 42, having a handle 43 at its free end, is pivoted at its other end, as by a ball-and-socket joint 44, in a base block 45 that is affixed to housing C. The upper end portion of thrust rod 33 located above sleeve 38 extends through a longitudinal slot 46 in lever 42. As a result, lever 42 rests upon the upper end of sleeve 38. When release lever 42 is pressed downward, it will force thrust rod 33 in the same direction against the tension of spring 36 and will cause the desired retraction or release movement of pressure roller 20.

For convenience, a guide roller 47 has been journaled between arms 48, 48' that rise from bracket 24 to a height that brings the bottom of periphery of roller 47 into tangency with the flat stretch of strip E that is engaged with mask B of the printer. Roller 47 prevents binding of the strip E at the exit portion of the mask and whipping action of the stretch intervening between mask B and meter roller 10 that otherwise might result from sudden deceleration of said meter roller.

The operation of the propulsion device will now be described. Assuming that a sensitized paper strip E has been threaded from the supply magazine (not shown) through the printer mask B, under guide roller 47, and between meter roller 10 and pressure roller 20 to the wind-up spool (not shown), operation of the printer in the customary manner by an operator will produce successive precisely metered intermittent revolutions of meter roller 10 in counter-clockwise direction (Figs. 1, 3 and 4). During the greater part of each revolution, strip E will be propelled by the frictional grip and traction of meter roller 10 and pressure roller 20 in the manner shown in Fig. 3. This view shows meter roller 10 in a posi-

tion immediately preceding arrival of an axial row of sprocket teeth 19 at the dead-center position of Fig. 4. In Fig. 3 position, each sprocket tooth 19 will have its tapered point 19'' moving into a perforation 49 of strip E, which perforation will be assumed to be one of the hinge perforations of the type of print strip illustrated in Fig. 5. Under a certain set of atmospheric conditions, all picture frames of strip E might be found to register exactly with the printing aperture of mask B of the printer, in which situation each row of strip perforations would become perfectly aligned with the teeth 19 of meter roller 18. When that happens, continued rotational movement of roller 18 from the Fig. 3 position would result in precise fitting of the roots 19' of teeth 19 in the respective perforations, even if pressure roller 20 were not released. Under other atmospheric conditions, as when the relative humidity is lower, linear contraction of strip E would cause such displacement in location of the perforations that the tooth 19 might tear the perforation, i. e. the front flank of each tooth root would cut through the front edge of the perforation that is being entered. Mutilation of the strip in this manner would be added to progressively increasing misalignment of successive strip frames with the mask aperture and consequent aggravation of the unbalanced printing of pictures in the strip frames, such as shown at the right hand end of Fig. 5.

Fig. 4, on the other hand, shows the beneficial results of employment of the improved propulsion device. Continuing the action from the point disclosed in Fig. 3, further counter-clockwise movement of meter roller 18 will cause cam nosings 17, 17' to press downwardly on follower rings 32, 32' and thereby depress pressure roller 20 until the said follower rings are in rolling contact with dwell surfaces 18, 18' of the cam nosings. This release of pressure roller 20 will occur just before sprocket tooth is fully entered in the engaged perforation. Therefore, strip E will be freed from the grip of rollers 18 and 20 and will in effect be floating and will yield to flank pressure of the sprocket teeth 19 as their roots 19' enter the corresponding strip perforations. The floating strip thus will be permitted to seek the properly centered tooth-in-perforation engagement shown in Fig. 4. While pressure roller 20 is being held down by engagement of follower rings 32, 32' with the dwell surfaces 18, 18' of cam nosings 17, 17', sprocket teeth 19 will perform the propulsion of strip E. After this condition has terminated, the sprocket teeth will have withdrawn from the strip perforations and pressure roller 20 will have been restored by action of spring 36 to its elevated operative position, so that further strip propulsion will be performed by frictional roller traction alone.

It should now be apparent that the intermittent release of tractive effect of the two rollers will cause readjustment of strip E in the vicinity of the printing station once for every frame that passes through that station and consequent equalization of the registration of each frame upon being stopped therein for the printing exposure.

Fig. 5 shows a sensitized strip perforated for accordion-folding of its picture frames after printing and developing have been completed. In this instance, there is a single row of perforations 49 between each two adjoining frames X and Y. These perforations are intended to afford weakened hinge portions in the intervening material of the strip to facilitate the accordion-folding operation and also to cooperate with the sprocket teeth of the propulsion device.

It will be observed that the picture represented in frame X is properly centered, whereas the picture in frame Y is too far to the right and part of the subject has been cut off. This latter picture represents the result of accumulated misalignment or faulty registration of the frame in the printer's mask aperture at the time of printing exposure. This result would be obtained toward the trailing end of a strip if the improved registration equalizing propulsion device were not used.

Fig. 6 shows modified perforations that have more than one functional purpose. Between each two picture frames there are two parallel rows 50 and 51 of perforations of irregular shape designed to afford deckled edges upon severance of the frames along the lines defined by these rows. If the prints are to be bound in booklet form, severance will be done along the line of perforations 50 only, as will be understood more fully as the description progresses. The narrow cross-strip of paper 52 intervening between rows 50 and 51 is intended to be used as a binding strip when booklets are to be produced. Therefore, it is our practice to provide additional perforations 53 in this cross-strip for engagement by binding fasteners (not shown). As disclosed, there are two pairs of perforations of different sizes in this row to accommodate either of two standard types of booklet covers now being used. When severance of the strip as a whole along perforations rows or lines 50 alone is effected, booklet leaves each comprise a picture frame and a binding strip. In each such leaf, the row of perforations 51 where severance has not occurred will provide intervening hinge portions that will aid turning of the leaves in the bound booklet.

In Fig. 6 there is also illustrated a special perforation 54 intended solely for strip propulsion purposes. This perforation is centrally located in binding cross-strip 52 and is elongated transversely of strip E as a whole. It has been made much larger in size to permit use of a sufficiently large and strong sprocket tooth. In the use of this modified form of perforation, meter roller 18 will be provided with a single central tooth 55 of matching size and form as shown in Fig. 7. It is intended that this and other variations in the number, form and disposition of sprocket teeth and cooperating strip perforations may be utilized within the scope of the invention as defined in the appended claims.

Although our strip propulsion device has been described and illustrated in its application to a photographic printer having feed mechanism of the precision metering type, wherein the strip is intermittently advanced frame by frame through the printing station and the need for repeated equalization of the frames is clearly apparent, it is conceivable that the improved propulsion device can be used in machines which feed strips uninterruptedly through operating stations but require accurate registration of successive strip sections as they pass through said stations. Therefore, it is desired to have it understood that our invention is not restricted to intermittent feeding mechanism alone.

Having thus described the invention, what we claim is:

1. In a propulsion device for strip feeding mechanism operative upon a strip provided with

traction perforations uniformly spaced longitudinally thereof and having a housing and a driven shaft journaled therein; the combination of a meter roller operatively connected to said driven shaft, a pressure roller opposed to said meter roller for propulsion of a strip through the nip of said rollers, at least one sprocket tooth projecting radially from the periphery of the meter roller for successive propelling and aligning engagement with the strip perforations, a supporting frame for the pressure roller, said supporting frame comprising side plates pivotally mounted on the housing of the strip feeding mechanism for independent swinging movement toward and from the meter roller, and a spacer rod extending between the free end portions of said side plates with its ends pivotally connected to the latter in a manner to permit differential swinging movement of the side plates, the pressure roller having its ends journaled in the side plates of the frame in a manner to permit it to wobble angularly under differential swinging movements of said side plates whereby to accommodate it to inequalities of thickness of the fed strip, means to apply yieldable thrusting pressure to said frame whereby to urge the pressure roller toward the meter roller, the latter means comprising a thrust rod having one end connected to the center of said spacer rod by a universal joint connection, means to slidably support the opposite end portion of said thrust rod, a sleeve longitudinally adjustable on said thrust rod, a compression spring around said thrust rod between its support and said sleeve, and means cooperative with said thrust rod by which the supporting frame can be manually moved to release the pressure roller from strip engagement without disturbing the tension of the compression spring as predetermined by the adjusted position of the sleeve on said thrust rod.

2. In a propulsion device for strip feeding mechanism having a housing and a driven shaft journaled therein, the combination of a feed roller actuated by said driven shaft, a pressure roller opposed to said feed roller for propulsion of a strip through the nip of said rollers, a supporting frame for the pressure roller, said supporting frame comprising side plates pivotally mounted on the housing of the strip feeding mechanism for independent swinging movement toward and from the feed roller, and a spacer rod extending between the free end portions of said side plates with its ends pivotally connected to the latter in manner to permit differential swinging movement of the side plates, the pressure roller having its ends journaled in the side plates of the frame in manner to permit it to wobble angularly under differential swinging movements of said side plates whereby to accommodate it to inequalities of thickness of the fed strip, means to apply yieldable thrusting pressure to said frame whereby to urge the pressure roller toward the feed roller, the latter means comprising a thrust rod having one end connected to the center of said spacer rod by a universal joint connection, means to slidably support the opposite end portion of said thrust rod, a sleeve longitudinally adjustable on said thrust rod, a compression spring around the thrust rod between its support and said sleeve, and means cooperative with said thrust rod by which the supporting frame can be manually moved to release the pressure roller from strip engagement without disturbing the tension of the compression spring as predetermined by the adjusted position of the sleeve on said thrust rod.

3. In a propulsion device for strip feeding mechanism having a housing and a driven shaft journaled therein, the combination of a feed roller actuated by said driven shaft, a pressure roller opposed to said feed roller for propulsion of a strip through the nip of said rollers, a supporting frame for the pressure roller, said supporting frame comprising side plates pivotally mounted on the housing of the strip feeding mechanism for independent swinging movement toward and from the feed roller, and a spacer rod extending between the free end portions of said side plates with its ends pivotally connected to the latter in manner to permit differential swinging movement of the side plates, the pressure roller having its ends journaled in the side plates of the frame in manner to permit it to wobble angularly under differential swinging movements of said side plates whereby to accommodate it to inequalities of thickness of the fed strip, means to apply yieldable thrusting pressure to said frame whereby to urge the pressure roller toward the feed roller, the latter means comprising a thrust rod having one end connected to the center of said spacer rod by a universal joint connection, means to slidably support the opposite end portion of said thrust rod, a sleeve longitudinally adjustable on said thrust rod, a compression spring around said thrust rod between its support and said sleeve, and means cooperative with said thrust rod by which the supporting frame can be manually moved to release the pressure roller from strip engagement without disturbing the tension of the compression spring as predetermined by the adjusted position of the sleeve on said thrust rod, said last mentioned means comprising a lever arm pivotally mounted in connection with the housing of the strip feeding mechanism to extend transverse to the axis of the thrust rod and adapted to embrace the latter above and so as to abut the upper end of said sleeve.

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HENRY F. RUSCHMANN.

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