

"Xerographic apparatus for label printer"

This invention relates to a xerographic apparatus for a label printer, and especially to such an apparatus which uses a continuous label strip constituted of a backing sheet having a series of labels releasably attached thereto, and to such an apparatus which eliminates any slack arising in the continuous label strip ahead of the toner fixing section.

For labeling purposes there is commonly used a continuous label strip fabricated by trimming labels obtained from a label sheet into an appropriate shape and then releasably attaching them serially at appropriate intervals to the side of a backing strip which has been coated with a release agent. While the printing of the required information onto the labels has most often been carried out by the use of a thermal printer, xerographic printing apparatus has also recently come into use.

In some cases, although the individual labels are separated from each other by creases, they are attached to backing strip without any space between them, whereas in other cases labels trimmed from label sheets and with the scrap material from the trimming removed are attached with predetermined spaces between them. The latter type of continuous label strip is widely used because of such various advantages as that the labels can be freely designed to have rounded corners or to be circular, triangular, hexagonal, flower shaped or the like, that the label strip has regions with different transmittance which can be used for detecting the label pitch (the interval at which the labels are attached to the backing strip) without the need to apply any other special mark or the like, and that the labels are easy to detach from the backing strip.

Referring to Fig. 1 of the accompanying drawings, one form of continuous label strip A consists of labels L cut from a label sheet attached at prescribed intervals to a backing strip S, and regions D of the backing strip S not overlaid with labels L, which regions generally have their exposed

surface coated with a silicon-based release agent. The thickness of the continuous label strip A is thus different between these regions D and the regions where the labels L are overlaid on the backing strip S.

It has been proposed to use a xerographic apparatus in which the peripheral speed of the photosensitive drum and that of the toner fixing section are precisely the same and determine the speed of conveyance of the continuous label strip A.

When label printing is conducted with a continuous label strip A of the foregoing type loaded in such a xerographic apparatus, slippage may occur between the rollers at the toner fixing section and the continuous label strip A passing therethrough because of the lower coefficient of friction of the regions D coated with the exposed release agent, and at the transition regions between the regions where the labels L are overlaid on the backing strip S and the regions D consisting solely of the backing strip S, which leads to slippage in the conveyance of the continuous label strip A at the toner fixing section.

As a result, the conveyance rate of the continuous label strip may become lower at the toner fixing section than at the photosensitive drum, which causes the portion of the continuous label strip ahead of the toner fixing section to become slack. In the case of continuous printing or the like, the amount of this slack progressively accrues and may cause jamming.

One object of the invention is to provide a xerographic apparatus for a label printer which detects and eliminates any slack occurring in continuous label strip ahead of the toner fixing section.

The invention provides xerographic apparatus for a label printer that is arranged to use a continuous label strip of labels releasably attached to a backing sheet, comprising: a rotatable photosensitive drum; toner fixing means; label strip conveyance means disposed between the photosensitive

drum and the toner fixing means; slack detection means positioned between the label strip conveyance means and the toner fixing means for detecting slack in the label strip; and means responsive to the output of the slack detection means for increasing the speed of transport of the label strip through the toner fixing means when the slack detection means detects slack in the label strip.

The apparatus may comprise an independent motor for driving the toner fixing section and means responsive to the output of the slack detection means for controlling the speed of the toner fixing section drive motor.

Instead, the apparatus may comprise means for applying a clamping force to the continuous label strip for conveyance thereof at the toner fixing section and means responsive to the output of the detection means for increasing the clamping force of the clamping force means.

Various forms of xerographic apparatus constructed in accordance with the invention will now be described by way of example only with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of a continuous label strip in fanfold form;

Figure 2 is a schematic side view of one form of xerographic apparatus;

Figure 3 is a block diagram of a controller for a toner fixing section speed control motor;

Figure 4 is a block diagram of a controller for a toner fixing section pressure control motor;

Figure 5 is a side view of a toner fixing section pressure control mechanism;

Figure 6 is a circuit diagram showing a motor stopping circuit; and

Figure 7 is a top view of a mechanism for setting the positions of sprockets and detection elements in accordance with the width of the continuous label strip.

Referring to the drawings, and initially to Figure 1, one form of fanfold continuous label strip A has sprocket holes P

along both edges of a backing strip S and is folded at perforations M provided to make it easily separable into sections of unit size. The fanfold strip is convenient for use in continuously printing different types of data since the sections printed with any particular required data can thereafter be easily detached and the printing apparatus need not be provided with a wind-up mechanism as is required when using roll strip.

Referring now to Figure 2, one form of xerographic apparatus for a label printer according to the invention that uses a continuous label strip of the fanfold type comprises a photosensitive drum 1 onto which falls a light beam 2 emitted by a semiconductor laser, an LED array or other such means capable of emitting a light beam in accordance with image data received from an electrostatic latent image forming means (not shown). With the drum 1 are associated: a cleaning brush 3, a photosensitizing charger 4; a developer 5; and an image transfer charger 6. A toner fixing section indicated generally by the reference numeral 8 comprises a heat roller 8A and a auxiliary roller 8B. A pair of sprockets 10 (only one shown), positioned between the photosensitive drum 1 and the toner fixing section 8, are provided on their peripheries with regularly spaced pins 10a for engagement with the sprocket holes P of the continuous label strip A. The two sprockets 10 are provided on opposite sides of the continuous label strip A and are arranged in a known manner to be adjustable symmetrically with respect to the centre of the continuous label strip A for setting at positions suitable for the width of the continuous label strip A in use. Each of a pair of paper guide members 11 is clamped between a boss of one of the sprockets 10 and a flange 10b and engaged with a pin 14 that restrains the paper guide member against rotation while it is movable together with the sprocket 10 in the width direction of the continuous label strip A. An arm 12 of each paper guide member 11 extending in the direction of the photosensitive drum 1 constitutes a paper guide 12a. While

the pins 10a of the sprocket 10 provide a degree of guidance for the continuous label strip A, the paper guides 12a operate in cooperation with the pins 10a to extend the range of this guidance. A pair of paper bails 15 of well-known design are movable together with the sprockets 10 in the width direction of the continuous label strip A and are, for instance, screw-attached to the paper guide member 11 so as to be swingable between a first, open position in which the continuous label strip A is free from restraint thereby and a second, closed position in which the paper is prevented by the bails from lifting off the sprockets. A holder 16, mounted on an arm 13 formed as extension of one of the paper members 11 in the direction of the toner fixing section 8, supports a light-emitting element 17 and a light-receiving element 18 positioned to enable monitoring of the amount of light reflected from an edge portion of the continuous label strip A (an edge portion not affected by the sprocket holes P). The position of the light emitting element 17 and light receiving element 18 varies with the position of the paper guide member 11 so that it is automatically adjusted as appropriate for the particular type of continuous label strip A in use.

The photosensitive drum 1 and the sprocket 10 are driven by a common power source, for example, a motor (not shown), through a common drive mechanism (likewise not shown) so as to rotate at the same peripheral speed.

The toner fixing section 8 is driven independently of the photosensitive drum system by a toner fixing section speed control motor 20 which, as shown in Figure 3, is controlled by a controller consisting of a motor drive circuit 21, a speed control circuit 22 and a light quantity comparator 23.

The light quantity comparator 23 outputs a speed switchover command signal to the speed control circuit 22 in accordance with whether the output of the light receiving element 18 based on the amount of light reflected by the continuous label strip A is higher or lower than a reference level, in

response to which signal the peripheral speed of the rollers 8A and 8B of the toner fixing section 8 is switched between a speed equal to, and a speed faster than, that of the photo-sensitive drum 1.

Preferably, the reference level is a reference range of predetermined breadth, and the switchover signal is output only when the output of the light receiving element 18 goes outside that range.

In the foregoing arrangement, the electrostatic latent image forming means for emitting the beam 2, the photo-sensitive drum 1 and the other operating mechanisms are controlled by a controller (not shown) for the apparatus as a whole so as to print image information onto the labels L of the continuous label strip A.

As seen in Figure 4, the continuous label strip A is conveyed in from the left, toner images are transferred to the labels L from the photosensitive drum 1 at the image transfer charger 6, the continuous label strip A is conveyed to the toner fixing section 8 where the toner images are fixed on the labels, and the continuous label strip A with the printed labels is discharged to the right.

Since as shown in Figure 1 the continuous label strip A has the labels L fixed on its backing strip S with predetermined spacings, discrete regions D consisting solely of the backing strip S are present from place to place. These regions D consisting solely of the backing strip S have exposed surfaces coated with release agent with a low coefficient of friction and, moreover, the thickness of the continuous label strip A is different between the regions D and the regions overlaid with the labels L. As a result, when the continuous label strip A passes through the toner fixing section 8 the heat roller 8A tends to bounce with respect to the auxiliary roller 8B and that, in conjunction with the lower coefficient of friction at the regions D, causes slipping between the toner fixing section 8 and the continuous label strip A.

The continuous labels strip A therefore tends to become

slack ahead of the toner fixing section 8, and to form a loop as shown by the two-dot-chain line in Figure 2. This loop reduces the proportion of the light emitted by the light emitting element 17 that is reflected from the continuous label strip A onto the light receiving element 18, so that the output of the light receiving element decreases. When that output falls below the reference level set in the light quantity comparator 23, the light quantity comparator 23 issues a speed switchover command signal to the speed control circuit 22.

As a result, the speed of the toner fixing section speed control motor 20 is increased, raising the peripheral speed of the toner fixing section 8 above that of the photo-sensitive drum 1 and the sprocket 10. As this increases the amount of conveyance of the continuous label strip per unit time, the slack is taken up.

Once the slack has been removed from the continuous label strip A, the output of the light receiving element 18 again rises above the reference level and, accordingly, the peripheral speed of the toner fixing section 8 is returned to that of the photosensitive drum 1 and the sprocket 10.

In the apparatus just described, slack is removed from the continuous label strip A by controlling the speed of the rollers at the toner fixing section 8. Referring now to Figure 4, in a second form of apparatus according to the invention slack in the continuous label strip A is taken up by controlling the gripping force applied for conveying the continuous label strip A at the toner fixing section 8.

In the second form of apparatus, the toner fixing section 8 is driven by a separate power source from that used to drive the photosensitive drum 1 and the speed of the toner fixing section rollers is set to be higher than that of the photo-sensitive drum 1. The rate of conveyance of the continuous label strip A is varied by raising and lowering the contact pressure between the heat roller 8A and the auxiliary roller 8B.

As shown in Figure 4, the light quantity comparator 23 outputs a pressure switchover command signal for controlling the contact pressure of the toner fixing section 8 in accordance with whether the output of the light receiving element 18 based on the amount of light reflected by the continuous label strip A is higher or lower than the reference level. Specifically, when the aforesaid output is lower than the reference level, the light quantity comparator 23 outputs a command signal "H" for increasing the contact pressure between the heat roller 8A and the auxiliary roller 8B. The command signal "H" is forwarded to a one-shot multivibrator 24 and then through a forward rotation control circuit 26 and a motor drive circuit 28, causing a pressure control motor 29 of the toner fixing section to rotate in the forward direction for a prescribed period of time. When the signal received from the light receiving element 18 again rises above the reference level, the light quantity comparator 23 outputs a command signal "L" for decreasing the contact pressure between the heat roller 8A and the auxiliary roller 8B. The command signal "L" is forwarded to a one-shot multivibrator 25 and then through a reverse rotation control circuit 27 and the motor drive circuit 28, causing the pressure control motor 29 to rotate in the reverse direction for a prescribed period of time.

The pressure control mechanism of the toner fixing section 8 is shown in Figure 5. The heat roller 8A of the toner fixing section 8 is rotatably mounted on one end of a roller support lever 31. The lever 31 is pivotally supported by a shaft 32 and a pin 31a projects from the end of the lever 31 remote from the roller 8A. A roller operating lever 33 is pivoted at one end on the shaft 32 and has an arm 33a which extends to a position opposed to the pin 31a. A pin 33b projects from near the tip of the operating lever 33, at the end of the operating lever remote from the shaft 32. A spring 34 connected in compression between the roller support lever 31 and the roller operating lever 33 acts mainly to urge the

roller support lever 31 clockwise as seen in Figure 5 and thus apply pressure to the heat roller 8A. A cam 37 and a gear 38 formed integrally therewith are rotatably attached to one end of a pressure regulation lever 35 pivotally supported on a shaft 36 and having a pin 35a projecting from the other end thereof. The cam 37 slidably contacts the pin 33b of the roller operating lever 33. A spring 39 urges the roller operating lever 33 counterclockwise, applying a force tending to separate the heat roller 8A and the auxiliary roller 8B. A gear 40 fixed on the shaft of a motor (not shown) for controlling the engagement between the heat roller 8A and the auxiliary roller 8B is disposed to mesh with the gear 38. A cam 41 fixed on the shaft of the motor 29 (Figure 4) makes sliding contact with the pin 35a of the pressure regulation lever 35.

Similarly to what was explained earlier, when slack occurs in the continuous label strip A, the output of the light receiving element 18 drops because the continuous label strip A loops away from the holder 16 and reflects less of the light from the light emitting element 17 onto the light receiving element 18, and when the level of this output falls below the reference level, the light quantity comparator 23 outputs the pressure switchover command signal "H", thus activating the one-shot multivibrator 24 and, via the forward rotation control circuit 26 and the motor drive circuit 28, causing the toner fixing section pressure control motor 29 to rotate in the forward direction for a period of time determined by the characteristics of the multivibrator 24. As a result, the cam 41, initially in contact with the pin 35a at a small-radius portion of the cam, is rotated to a position in which the large-radius portion of the cam comes in contact with the pin 35a. This causes the pressure regulation lever 35 to rotate clockwise, whereby the cam 37 moves upward as the gear 38 rolls along the gear 40. The cam 37 thus pushes the pin 33b upward, causing the roller operating lever 33 to rotate clockwise against the force of the spring 34. As a

result, the spring 34 is compressed and the force exerted by the spring 34 between the roller operating lever 33 and the roller support lever 31 is increased, thereby increasing the pressure with which the heat roller 8A contacts the auxiliary roller 8B.

Since the peripheral speed of the toner fixing section rollers is set to be faster than that of the photosensitive drum 1 and the sprocket 10, the stronger contact pressure between the heat roller 8A and the auxiliary roller 8B resulting from the foregoing operation increases the rate at which the continuous label strip A is conveyed at the toner fixing section 8, and the slack in the continuous label strip A is thus taken up.

Once the slack has been removed from the continuous label strip A, the output of the light receiving element 18 again rises above the reference level so that the light quantity comparator 23 outputs a command signal "L" to activate the one-shot multivibrator 25, whereupon the one-shot multivibrator 25 and the reverse rotation control circuit 27 operate to rotate the pressure control motor 29 in the reverse direction for a period of time determined in the characteristics of the multivibrator 25. This causes the cam 41 to rotate to make contact with the pin 35a at its small-radius portion instead of its large-radius portion. Therefore, the pressure regulation lever 35 rotates counterclockwise under the force of the spring 39 as the pin 35a of the pressure regulation lever 35 follows the cam 41a. As a result, the spring 34 is relaxed and the force exerted by the spring decreases so that the heat roller 8A applies less pressure to the auxiliary roller 8B and this in turn readjusts the conveyance rate of the continuous label strip A at the toner fixing section 8 to that at the photosensitive drum 1.

In either of the two forms of apparatus described above, undesirable hunting may occur if the width of the reference level (range) is set too narrowly. This problem can be

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overcome by appropriately broadening the reference range or by providing the circuit with a timer function for cancelling reverse rotation operations of less than a prescribed time length.

When toner fixing is not being conducted in the toner fixing section 8, the heat roller 8A is separated from the auxiliary roller 8B by operating a motor (not shown) to rotate the gear 40 by a prescribed amount. This rotation of the gear 40 is transmitted to the gear 38 to cause the small-radius portion of the cam 37 integral therewith to contact the pin 33b. As a result, the roller operating lever 33 rotates counterclockwise as the pin 33b under the action of the spring 39, follows the cam 37. In the course of the rotation of the roller operating lever 33, its arm 33a strikes against the pin 31a and after that point the roller support lever 31 is also rotated counterclockwise. The heat roller 8A therefore separates from the auxiliary roller 8B.

In the arrangement shown in Figure 5, the cam 37 (motor not shown) for engaging and disengaging the heat roller 8A and the auxiliary roller 8B and the cam 41 (motor 29) for regulating the pressure of the heat roller 8A against the auxiliary roller 8B are provided as independent components. Alternatively, however, it is possible to use an arrangement wherein both of these operations are conducted using a single cam.

In the arrangement shown in Figure 4, one-shot multi-vibrators 24 and 25 are used for setting the time period during which the pressure control motor 29 is rotated and the actual amount of rotation of the cam 41 is regulated by open loop control.

It is alternatively possible to regulate the amount of cam 41 rotation by closed loop control without using a multi-vibrator. As shown in Figure 6, this can be accomplished for example by connecting a parallel circuit consisting of a limit switch SH and a diode DH to one terminal of the motor 29 and a parallel circuit consisting of a limit switch SL and

a diode DL to the other terminal thereof.

The arrangement is such that when the pin 35a is in contact with the small-radius (low) portion of the cam 41, the limit switch SL is open and the limit switch SH is closed. If a forward rotation signal is produced at this time, current will pass through the limit switch SH, the motor 29, and the diode DL as indicated by solid arrow in Figure 6 and the motor 29 will rotate in the forward direction to cause the cam 41 to rotate from the position at which the pin 35a contacts its small-radius portion to the position at which the pin 35a contacts its large-radius (high) portion, thus closing the limit switch SL and opening the limit switch SH. When the limit switch SH opens, the motor 29 stops, because forward rotation current cannot pass through the diode DH.

The closing of the limit switch SL establishes a reverse rotation signal standby state. When a reverse rotation signal is produced, current will thus pass through the limit switch SL, the motor 29 and the diode DH as indicated by the broken line arrow in Figure 6, and the motor 29 will rotate in the reverse direction to cause the cam 41 to rotate and close the limit switch SH again while, at the same time, causing the limit switch SL to open when the small-radius portion of the cam comes into contact with the pin 35a. The motor 29 then stops, because reverse rotation current cannot pass through the diode DL.

While the paper guide member 11 provided in conjunction with the sprocket 10 in the two embodiments described above extends up to the downstream side of the photosensitive drum 1, it is alternatively possible to extend it as far as the upstream side of the drum.

Moreover, the reflection type slack detection means can be replaced with transmission type detection means.

In addition, instead of using only a single light receiving element it is possible to use a multistage line sensor or a multistage level sensor and to subdivide the peripheral

rotation control range or the contact pressure control range into a number of stages.

Further, in place of the continuous label strip conveyance means using the sprockets 10, there can be used a pin-tractor conveyance system in which the continuous label strip is laid on the flat upper section of an endless belt supported by two laterally spaced pulleys and conveyed together with the belt by engagement of pins formed on the belt with the sprocket holes of the label strip.

While it is possible to use either a sprocket type conveyance system or a pin-tractor conveyance system in which a flat conveyance path of a predetermined length is formed by supporting an endless belt with pins on two laterally separated pulleys, the sprocket system proves to be advantageous, as will be understood from the following comparison.

Because, in the pin-tractor system, the label strip must travel along the flat path formed by the endless belt, the path length from the drum 1 to the toner fixing station 8, and therefore the time required for the information transferred to the continuous label strip A (the labels L) to be output from the toner fixing section 8 in printed form, is increased. The pin-tractor system thus prolongs the period between data input and the time at which the output information can be visually checked. Moreover, the section of the continuous label strip A that remains between the photosensitive drum 1 and the toner fixing section 8 after all of the printed labels have been output, and which cannot be used for printing, becomes longer, thus increasing the amount of the label strip that goes to waste. Another disadvantage is that the xerographic apparatus becomes longer in the direction of the label strip conveyance.

When the sprocket system is used, the short length of the xerographic apparatus in the direction of label strip conveyance advantageously makes it possible to dispose the photosensitive drum 1 and the toner fixing section 8 closer to each other, thus mitigating the aforesaid disadvantages of

the pin-tractor system. Furthermore, the sprocket system can be used in conjunction with a paper guide member for preventing snaking of the continuous label strip A.

Moreover, it is possible to use roll label strip as the continuous label strip in place of the fanfold label strip. Roll label strip is particularly advantageous for use in cases where the same data is to be repeatedly printed continuously and in large volume. In an apparatus which uses roll label strip without sprocket holes, a roller drive system is used in place of the sprocket or pin-tractor system. It is also preferable to provide the apparatus with a mechanism for winding up the label strip after printing.

In a xerographic apparatus for label printing that uses a continuous label strip consisting of labels cut from a label sheet releasably attached to a backing strip, the foregoing constructions provide improved apparatus which prevents jamming by monitoring the continuous label strip for occurrence of slack owing to slipping at the toner fixing section and immediately eliminating any slack that arises and which further enables printing of labels as desired without undue waste of the label strip.

As mentioned earlier, the light emitting element 17 and the light receiving element 18 supported on the arm 13 of the paper guide member 11 by the holder 16 have to be appropriately positioned with respect to the width of the continuous label strip A. A mechanism for that purpose is shown in Figure 7.

The sprockets 10 are mounted on a drive shaft 9 so as to rotate integrally therewith but to be slidable in the axial direction of the drive shaft 9.

Beneath the drive shaft 9 are a gear 43 that is capable only of rotating, and cannot be displaced in any direction, and a pair of strip width setting plates 44 and 45 formed with racks 44a and 44b that mesh with opposite sides of the gear 43. An upright portion of the strip width setting plate 44 at the end thereof nearer the sprocket 10 is formed with a

bifurcated member 44b, between the sides of which the sprocket 10 fits with sufficient clearance that the rotation of the sprocket is not obstructed. The strip width setting plate 45 is similarly configured with respect to the other sprocket (not shown).

Thus the sprockets 10 can be symmetrically moved in the width direction of the label strip by the linkage mechanism constituted by the strip width setting plate 44, the gear 43 and the strip width setting plate 45. Since the positions of the light emitting element 17 and the light receiving element 18 have a fixed relationship to the position of the paper guide member 11, they are automatically positioned properly with respect to the width of the continuous label strip A.

When the continuous label strip A is replaced with one of a different width, the sprockets 10 are repositioned as appropriate for the new strip width, using the mechanism shown in Figure 7. As this operation also moves the paper guide member 11, the light emitting element 17 and the light receiving element 18 mounted on the holder 16 are positioned so as to be able to project light onto and monitor the light reflected from the edge of the new continuous label strip A. The light emitting element 17 and the light receiving element 18 are thus automatically able to carry out the detection function required for eliminating slack from the continuous label strip A.

For ensuring that the sprockets 10 will not be displaced by vibration or the like after once being properly positioned, the strip width setting plates 44, 45 and/or the gear 43 are arranged so that they can be releasably locked in place.

As was mentioned earlier, in place of the sprocket type conveyance system it is possible to use a pin-tractor conveyance system in which the continuous label strip is laid on the flat upper section of an endless belt supported by two laterally spaced pulleys and conveyed together with the belt by engagement of pins formed on the belt with the sprocket holes of the label strip. When this pin-tractor system is

used, the detector elements are mounted on a suitable member that is restrained from rotation but that moves in the width direction of the continuous label strip in response to the width setting operation.



Claims:

1. Xerographic apparatus for a label printer that is arranged to use a continuous label strip of labels releasably attached to a backing sheet, comprising: a rotatable photosensitive drum; toner fixing means; label strip conveyance means disposed between the photosensitive drum and the toner fixing means; slack detection means positioned between the label strip conveyance means and the toner fixing means for detecting slack in the label strip; and means responsive to the output of the slack detection means for increasing the speed of transport of the label strip through the toner fixing means when the slack detection means detects slack in the label strip.

2. Apparatus as claimed in claim 1, which comprises means for increasing the speed with which the toner fixing means is driven when the slack detection means detects slack in the label strip.

3. Apparatus as claimed in claim 1, which comprises means for increasing the pressure with which the label strip is gripped in the toner fixing means when the slack detection means detects slack in the label strip.

4. Apparatus as claimed in any one of claims 1 to 3, wherein the photosensitive drum is rotatable at a predetermined speed and the conveyance means is arranged to convey the label strip at a speed equal to the peripheral speed of the drum.

5. Apparatus as claimed in any one of claims 1 to 4, which is arranged to use a label strip having sprocket holes along either edge thereof.

6. Apparatus as claimed in any one of claims 1 to 5, wherein the conveyance means is adjustable to the width of a label strip and the slack detection means is coupled with the conveyance means.

7. Xerographic apparatus for a label printer substantially as hereinbefore described with reference to, and as shown in, Figures 2 and 3, or Figures 2, 3, and 7, or Figures 4 and 5,



or Figures 4, 5, and 7, or Figures 5 and 6, or Figures 5, 6, and 7, of the accompanying drawings.
