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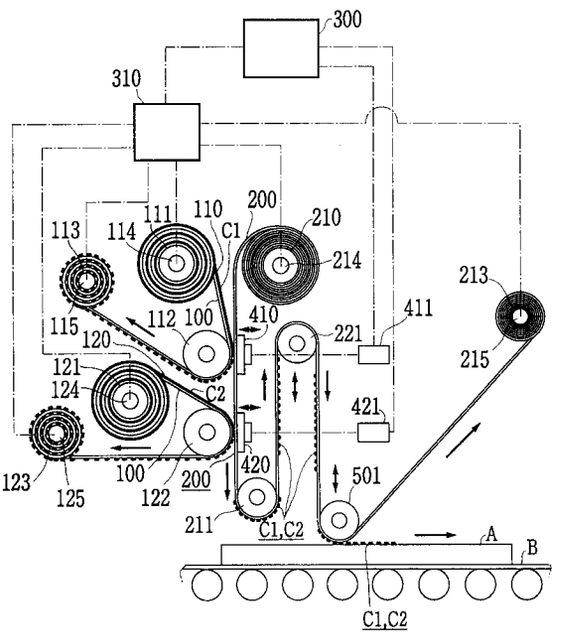
(54) Method and apparatus for high speed thermal transfer type printing.

(57) A thermal transfer type printing capable of realizing a high speed printing, an accurate multi-color printing, and a reduction of an interval between the successive printing operations. In this thermal printing, a first film (110) for carrying a thermally transferrable applied material and a second film (200) for receiving the applied material thermally transferred from the first film are provided. Then, a desired printing pattern is formed on the second film (200) by applying heat from the second film side to a desired part of the applied material on the first film (110) in a shape of the desired printing pattern, and the desired printing pattern formed on the second film is then thermally transferred to a printing target (A). The multi-color printing can be achieved by providing a plurality first films (110,120) carrying thermally transferrable applied material in different colors. The reduction of an interval between the successive printing operations can be achieved by providing a mechanism (221) for temporarily pooling a plurality of desired printing patterns sequentially formed on the second film (200), by bending a route of the second film passing out from a heating position of the printing head (420).

FIG.3



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BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a method and an apparatus for a thermal transfer type printing suitable for a high speed printing.

Description of the Background Art

An example of a known printer apparatus of a thermal transfer type (thermal printer) is disclosed in Japanese Patent Application Laid Open No. 3-227683 (1991).

The thermal printer disclosed in this reference comprises a first film having a carbon (applied material) which is thermally transferrable, a second film arranged to be in contact with this first film, a printing head for thermally transferring unnecessary portion of the carbon from the first film to the second film by heating the first film so as to leave the carbon in a shape of a desired printing pattern on the first film, and a thermal transfer roller for heating the first film with the desired printing pattern formed by the carbon thereon while pressing the first film against a printing target.

In such a conventional thermal printer, the printing pattern is formed by means of a controllable printer head, so that the sequential printing of the constantly varying printing patterns such as the bar codes can be realized easily.

However, in this type of a conventional thermal printer, in a case of making a multi-color printing, it has been necessary to provide a plurality of thermal printers of this type with carbons in different colors, and the printing in multiple colors of the desired multi-color printing must be made by using the plurality of thermal printers with the carbons in these multiple colors, one color by one color. For this reason, the multi-color printing using such a conventional thermal printer has been requiring a high cost for the equipments as well as a considerably long printing time. In addition, the printing in each one of the multiple colors is made by a separate thermal printer, so that the proper alignment of a printing area for each color has been difficult and deviated coloring can be caused easily.

Moreover, in such a conventional thermal printer, the unnecessary portion of the carbon is thermally transferred from the first film to the second film, but the area of the unnecessary portion is usually much larger than the area covered by the printing pattern, so that the printing head must be driven for a considerable amount of time using a considerable amount of energy for heating. To this end, it is possible to consider the possibility of thermally transferring the necessary portion from the first film to the second film instead to form the carbon in a shape of the desired printing pattern on the second film, and then thermally transferring the carbon in a shape of the desired printing pattern from the second film to the printing target. However, in such a case, the portion of the first film to be heated by the printer head must be in a shape of a mirror image of the desired printing pattern in order to obtain the printing in a shape of the normal image on the printing target, so that the controlling of the printing head becomes complicated and cumbersome.

Furthermore, in such a conventional thermal printer, the printing is made by first forming the desired printing pattern on the first film, then moving a portion of the first film having the desired printing pattern thereon to a location of the printing target to carry out the thermal transfer of the printing pattern at a location of the printing target. As a result, the printing head cannot be driven continuously and the formation of the next printing pattern by the printer head must be delayed until the moving of the current printing pattern to a location of the printing target object and the thermal transfer of the current printing pattern to the printing target are completed. Consequently, the interval between the successive printing operations has been considerably long, and therefore the sequential printing of a plurality of printing patterns has been time consuming.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a method and an apparatus for a thermal transfer type printing, capable of realizing a high speed printing without requiring a complicated controlling of the printing head.

It is another object of the present invention is to provide a method and an apparatus for a thermal transfer type printing, capable of realizing an accurate multi-color printing without deviated coloring at a high speed and a low cost.

It is another object of the present invention is to provide a method and an apparatus for a thermal transfer type printing, capable of reducing an interval between the successive printing operations such that the sequential printing of a plurality of printing patterns can be made at a high speed.

According to one aspect of the present invention there is provided an apparatus for thermal transfer type printing, comprising: first film means for carrying a thermally transferrable applied material; second film means for receiving the applied material thermally transferred from the first film means; printing pattern formation means for forming a desired printing pattern on the second film means by applying heat from the second printing

means side to a desired part of the applied material on the first film means in a shape of the desired printing pattern; and thermal transfer means for thermally transferring the desired printing pattern formed on the second film means to a printing target.

According to another aspect of the present invention there is provided an apparatus for thermal transfer type printing, comprising: first film means for carrying a thermally transferrable applied material; second film means for receiving the applied material thermally transferred from the first film means; printing pattern formation means for forming a desired printing pattern on the second film means by applying heat to a desired part of the applied material on the first film means in a shape of the desired printing pattern; printing pattern pooling means for temporarily pooling a plurality of desired printing patterns sequentially formed on the second film means by the printing pattern formation means, by bending a route of the second film means passing out from a heating position of the printing pattern formation means; and thermal transfer means for thermally transferring said plurality of desired printing patterns formed on the second film means and temporarily pooled by the printing pattern pooling means to a printing target.

According to another aspect of the present invention there is provided an apparatus for thermal transfer type printing, comprising: a plurality of first film means for carrying thermally transferrable applied material in different colors; second film means for receiving the applied material thermally transferred from said plurality of first film means; printing pattern formation means for forming a plurality of desired printing patterns in said different colors on the second film means by applying heat to a desired part of the applied material on each first film means in a shape of the desired printing pattern; and thermal transfer means for thermally transferring said plurality of desired printing patterns formed on the second film means to a printing target.

According to another aspect of the present invention there is provided a method of thermal transfer type printing, comprising the steps of: providing first film means for carrying a thermally transferrable applied material; providing second film means for receiving the applied material thermally transferred from the first film means; forming a desired printing pattern on the second film means by applying heat from the second film means side to a desired part of the applied material on the first film means in a shape of the desired printing pattern by printing pattern formation means; and thermally transferring the desired printing pattern formed on the second film means to a printing target by thermal transfer means.

According to another aspect of the present invention there is provided a method of thermal transfer type printing, comprising the steps of: providing first film means for carrying a thermally transferrable applied material; providing second film means for receiving the applied material thermally transferred from the first film means; forming a desired printing pattern on the second film means by applying heat from the second film means side to a desired part of the applied material on the first film means in a shape of the desired printing pattern by printing pattern formation means; temporarily pooling a plurality of desired printing patterns sequentially formed on the second film means by the printing pattern formation means, by bending a route of the second film means passing out from a heating position of the printing pattern formation means; and thermally transferring the desired printing pattern formed on the second film means to a printing target by thermal transfer means.

According to another aspect of the present invention there is provided a method of thermal transfer type printing, comprising the steps of: providing a plurality first film means for carrying thermally transferrable applied material in different colors; providing second film means for receiving the applied material thermally transferred from the first film means; forming a plurality of desired printing patterns in said different colors on the second film means by applying heat to a desired part of the applied material on each first film means in a shape of the desired printing pattern by printing pattern formation means; and thermally transferring said plurality of desired printing patterns formed on the second film means to a printing target by thermal transfer means.

Other features and advantages of the present invention will become apparent from the following description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic diagram of a first embodiment of a thermal transfer type printing apparatus according to the present invention.

Fig. 2 is a schematic diagram of a second embodiment of a thermal transfer type printing apparatus according to the present invention.

Fig. 3 is a schematic diagram of a third embodiment of a thermal transfer type printing apparatus according to the present invention.

Fig. 4 is a schematic diagram of a fourth embodiment of a thermal transfer type printing apparatus according to the present invention.

Fig. 5 is a schematic diagram of a fifth embodiment of a thermal transfer type printing apparatus

according to the present invention.

Fig. 6 is a schematic diagram of a sixth embodiment of a thermal transfer type printing apparatus according to the present invention.

Fig. 7 is a schematic diagram of a modified configuration for the apparatus of the first embodiment shown in Fig. 1.

Fig. 8 is a schematic diagram of a modified configuration for the apparatus of the second embodiment shown in Fig. 2.

Fig. 9 is a schematic diagram of a modified configuration for the apparatus of the third embodiment shown in Fig. 3.

Fig. 10 is a schematic diagram of a modified configuration for the apparatus of the fourth embodiment shown in Fig. 4.

Fig. 11 is a schematic diagram of a modified configuration for the apparatus of the fifth embodiment shown in Fig. 5.

Fig. 12 is a schematic diagram of a modified configuration for the apparatus of the sixth embodiment shown in Fig. 6.

Fig. 13 is a schematic diagram of a seventh embodiment of a thermal transfer type printing apparatus according to the present invention.

Fig. 14 is a detailed diagram of a main portion of the apparatus of Fig. 13.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to Fig. 1, a first embodiment of a thermal transfer type printing apparatus according to the present invention will be described in detail.

This thermal printer of Fig. 1 includes a first black film member 110, a first red film member 120, and a second film member 200. The first black film member 110 carries on one side a carbon black C1 as a thermally transferrable applied material for printing, while the first red film member 120 carries on one side a carbon red C2 as athermally transferrable applied material for printing. On the other hand, the second film member 200 carries no applied material initially, and receives the carbon black C1 and the carbon red C2 thermally transferred from the first black film member 110 and the first red film member 120.

The first black film member 110 and the first red film member 120 are initially provided inside a printer body in a state of being rolled up on cartridge type first black roll out reel 111 and first red roll out reel 121, respectively. Then, the first black film member 110 is rolled out with the carbon black C1 facing outwards, guided to be in a close contact with the second film member 200 by being wound around a black platen roller 112, and rolled up by a first black roll up reel 113. Similarly, the first red film member 120 is rolled out with the carbon red C2 facing outwards, guided to be in a close contact with the second film member 200 by being wound around a red platen roller 122 located below the black platen roller 112, and rolled up by a first black roll up reel 123.

The first black roll out reel 111, the first black roll up reel 113, the first red roll out reel 121, and the first red roll up reel 123 are detachably attached to a first black roll out motor shaft 114, a first black roll up motor shaft 115, a first red roll out motor shaft 124, and a first red roll up motor shaft 125, respectively, where each of the first black roll out motor (not shown), the first black roll up motor (not shown), the first red roll out motor (not shown), and the first red roll up motor (not shown) is controlled by a motor control unit 310. On the other hand, the black platen roller 112 and the red platen roller 122 are caused to rotate by the movements of the first black film member 110 and the first red film member 120, respectively, and positioned to be in a close proximity from each other.

The second film member 200 is initially provided inside a printer body in a state of being rolled up on a cartridge type second roll out reel 210. Then, the second film member 200 is rolled out from this second roll out reel 210, guided by first and second guide rollers 211 and 212 to have its one side which received the black carbon C1 and the red carbon C2 to be parallelly facing toward a surface of a printing target in a form of a cardboard A conveyed on a belt conveyer B, and rolled up by a second roll up reel 213.

The second roll out reel 210 and the second roll up reel 213 are detachably attached to a second roll out motor shaft 214 and a second roll up motor shaft 215, respectively, where each of the second roll out motor (not shown) and the second roll up motor (not shown) is also controlled by the motor control unit 310.

The motor control unit 310 controls the motors such that the roll out speed of the second film member 200 is in agreement with the roll out speed of the first black film member 110 and the first red film member 120.

Between the second roll out reel 210 and the first guide roller 211, along a side of the second film member 200 facing away from the first black film member 110, a black printing head 410 is located at a position facing against the black platen roller 112 across the first black film member 110 and the second film member 200, and a red printing head 420 is located at a position facing against the red platen roller 122 across the first black film member 110 and the second film member 200.

Each of the black printing head 410 and the red printing head 420 is equipped with a multiplicity of dot shaped heat generating resistor elements, and an amount of current flowing through each of

these heat generating resistor elements is controlled by a black printing controller 411 and a red printing controller 421, respectively. The black printing head 410 and the red printing head 420 are also controlled to move in a direction of moving toward or moving away from the black platen roller 112 and the red platen roller 122, respectively.

At a time of the thermal transfer of the carbon black C1 and the carbon red C2 from the first black film member 110 and the first red film member 120 to the second film member 200, the black printer head 410 and the red printer head 420 are moved toward the black platen roller 112 and the red platen roller 122 to press the second film member 200 against the black platen roller 112 and the red platen roller 122, respectively, such that the heat for causing the thermal transfer generated by the heat generating resistor elements can be transmitted to the first black film member 110 and the first red film member 120 through the second film member 200.

In this first embodiment, the black printing head 410 and the red printing head 420 are controlled to thermally transfer the portions of the carbon black C1 and the carbon red C2 on the first black film member 110 and the first red film member 120 that are necessary for forming a desired printing pattern to be printed on the second film member 200.

Except for a time of the thermal transfer described above, the black printing head 410 and the red printing head 420 are moved away from the black platen roller 112 and the red platen roller 122, respectively, and while the black printing head 410 and the red printing head 420 are located away from the black platen roller 112 and the red platen roller 122, the first black film member 110 and the first red film member 120 are not rolled up.

The motor control unit 310, the black printing controller 411, and the red printing controller 421 are connected with a printing control unit 300 for controlling a printing operation of this thermal printer as a whole.

Between the first guide roller 211 and the second guide roller 212, there is provided a thermal transfer roller 500, which is movable in a direction along the second film member 200 as well as in a direction of moving toward or moving away from the second film member 200.

At a time of the thermal transfer of the desired printing pattern from the second film member 200 to the cardboard A, the thermal transfer roller 500 is moved toward the second film member 200 to press the second film member 200 against the cardboard A while heating the second film member 200, and rolls along the second film member 200 between the first and second guide rollers 211 and 212, to print the entire desired printing pattern formed by the carbon black C1 and the carbon red C2 onto the cardboard A.

Here, this thermal transfer roller 500 has its surface portion formed by a soft layer with the hardness of about 30 such that the second film member 200 can be tightly pressed against the surface of the printing target even when the surface of the printing target is not smooth as in a back side surface of a corrugated cardboard. Thus, this thermal printer is capable of achieving an accurate printing even on a curved surface or a rough surface.

Now, the operation of this thermal printer of Fig. 1 will be described.

As the printing operation starts, the command signal for the desired printing pattern is supplied from the printer control unit 300 to the black printing controller 411 and the red printing controller 421. This command signal commands each of the black printing head 410 and the red printing head 420 to apply heat to a region in a shape of a positive normal image of the black and red portions in the desired printing pattern, respectively, just as they are expected to appear on the cardboard A when the printing is made.

Then, the black printing head 410 is moved toward the black platen roller 112 to press the second film member 200 against the first black film member 110, and the currents are supplied only to those heat generating resistor elements located within a region in the shape of the positive normal image of the black portion in the desired printing pattern, so as to generate the heat in a region in the shape of the positive normal image of the black portion in the desired printing pattern.

As a result, the heat generated by the black printing head 410 is transmitted to the first black film member 110 through the second film member 200, and the carbon black C1 located within a region in the shape of the positive normal image of the black portion in the desired black printing pattern is thermally transferred from the first black film member 110 to the second film member 200. When this thermal transfer of the carbon black C1 for the black portion in the desired printing pattern is finished, the black printing head 410 is moved away from the second film member 200.

Next, the second film member 200 is rolled to move a region having the black portion in the desired printing pattern formed therein to the position of the red platen roller 122.

Then, the red printing head 420 is moved toward the red platen roller 122 to press the second film member 200 against the first red film member 120, and the currents are supplied only to those heat generating resistor elements located within a region in the shape of the positive normal image of the red portion in the desired red printing pattern,

so as to generate the heat in a region in the shape of the positive normal image of the red portion in the desired printing pattern.

As a result, the heat generated by the red printing head 420 is transmitted to the first red film member 120 through the second film member 200, and the carbon red C2 located within a region in the shape of the positive normal image of the red portion in the desired red printing pattern is thermally transferred from the first red film member 120 to the second film member 200. When this thermal transfer of the carbon red C2 for the red portion in the desired printing pattern is finished, the red printing head 420 is moved away from the second film member 200.

Note here that, looking from the side of the second film member 200 which received the carbon black C1 and the carbon red C2, the desired printing pattern formed on the second film member 200 by the process described so far appears as a positive mirror image of the desired printing pattern to be printed on the cardboard A.

In this manner, the desired printing pattern is formed on the second film member 200 by the thermally transferred carbon black C1 and the carbon red C2. In this process, the movements of the first black and red film members 110 and 120 and the second film member 200 are controlled such that the second film member 200 and each of the first black and red film members 110 and 120 move together through the respective one of the heating positions of the black and red printing heads 410 and 420 while the respective one of the printing heads 410 and 420 is operated to carry out the heating operation, and the movements of the first black and red film members 110 and 120 are stopped otherwise.

Then, the second film member 200 with the desired printing pattern formed thereon is moved over the cardboard A until the desired printing pattern is placed at a thermal transfer printing position of the thermal transfer roller 500 provided over the cardboard A.

Next, the heated thermal transfer roller 500 is moved toward the second film member 200 to press the second film member 200 against the cardboard A, and then moved along the second film member 200 from the first guide roller 211 side to the second guide roller 212 side. As a result, the desired printing pattern formed on the second film member 200 is thermally transferred onto the surface of the cardboard A, such that the positive normal image of the desired printing pattern is printed on the cardboard A. After this thermal transfer of the desired printing pattern is finished, the thermal transfer roller 500 is moved away from the second film member 200 such that the second film member 200 is separated from the cardboard A.

When the printing of the desired printing pattern is finished in this manner, the cardboard A with the desired printing pattern printed thereon is conveyed out from the thermal printer by the belt conveyer B, and a new cardboard A to be printed next is conveyed into a thermal transfer printing position in the thermal printer between the first and second guide rollers 211 and 212. During this conveying and positioning of the previous and new cardboards A, the formation of the new desired printing pattern is carried out by the black and red printing heads 410 and 420 in the manner described above. Then, the second film member 200 with the new desired printing pattern formed thereon is moved to the thermal transfer printing position over the new cardboard A, and the printing of the new desired printing pattern onto the new cardboard A is carried out in the manner described above.

According to this first embodiment, the carbon black C1 and the carbon red C2 on the first black and red film members 110 and 120 are thermally transferred to the second film member 200 by applying heat from the second film member 200 side to the first black and red film members 110 and 120 by the black and red printing heads 410 and 420, so that the mirror image of the desired printing pattern can be formed on the second film member 200 by applying heat to a region in the shape of the normal image of the desired printing pattern by the black and red printing heads 410 and 420, such that the normal image of the desired printing pattern can be printed onto the cardboard A by thermally transferring the mirror image of the desired printing pattern on the second film member 200 at the thermal transfer roller 500. Therefore, there is no need for the black and red printing heads 410 and 420 to apply heat to a region in the shape of the mirror image of the desired printing pattern, so that the controlling of the black and red printing heads 410 and 420 can be a simple, straightforward one.

Moreover, the black and red printing heads 410 and 420 are controlled to apply heat to a region in the shape of the positive image containing only the portion constituting the pattern itself, so that the heating area required for the black and red printing heads 410 and 420 can be small, and consequently the time required for the formation of the desired printing pattern as well as the heating energy required for operating the black and red printing heads 410 and 420 can be reduced.

In addition, the black and red portions in the desired printing pattern are formed on the same region of the second film member 200 by the black and red printing heads 410 and 420, and the black and red portions in the desired printing pattern

formed on the second film member 200 are thermally transferred onto the cardboard A altogether at once by the thermal transfer roller 500, so that the thermal transfer type multi-color printing can be realized very easily at a high speed.

Moreover, unlike a conventional method which requires the black and red portions to be formed separately by two separate printers using black and red films, both of the black and red portions of the desired printing pattern can be formed in the same thermal printer, so that the problem of the deviated coloring can be prevented almost completely and therefore the highly accurate multi-color printing can be realized by using only one thermal printer, such that the cost required for the multi-color printing can also be reduced.

Furthermore, the black and red platen rollers 112 and 122 are located in a close proximity from each other, so that both of the black and red portions of the desired printing pattern can be formed on the same region of the second film member 200 easily, and the total amount of the second film member 200 required for the printing of the entire desired printing pattern can be reduced. Also, each of the first black and red film members 110 and 120 is rolled only while the heating operation by the respective one of the black and red printing heads 410 and 420 is carried out, so that the consumption of the first black and red film members 110 and 120 can be kept at the absolutely necessary minimum level.

Referring now to Fig. 2, a second embodiment of a thermal transfer type printing apparatus according to the present invention will be described in detail. Here, those elements which are substantially identical to the corresponding elements in the first embodiment of Fig. 1 described above will be given the same reference numerals in the figure, and their description will be omitted.

This second embodiment of Fig. 2 differs from the first embodiment of Fig. 1 described above in that a loop shaped second film member 201 is used instead of the second film member 200. In conjunction with this loop shaped second film member 201, the thermal printer is equipped with a driving roller 217 replacing the second guide roller 212 of the first embodiment, third and fourth guide rollers 218 and 219 replacing the second roll out reel 210 and the second roll up reel 213 of the first embodiment, and a tension roller 220 located between the driving roller 217 and the third guide roller 218 for applying a prescribed tension to the loop shaped second film member 201.

In this configuration of Fig. 2, the loop shaped second film member 201 is guided by first guide roller 211 and the driving roller 217 to have its one side which received the black carbon C1 and the red carbon C2 to be parallelly facing toward the surface of the cardboard A, and then wound around the third and fourth guide rollers 218 and 219 to circulate through a rectangular path.

The driving roller 217 is attached to a driving motor (not shown) controlled by the motor control unit 310 such that the moving speed of the loop shaped second film member 201 is in agreement with the roll out speed of the first black film member 110 and the first red film member 120.

The loop shaped second film member 201 is also guided by first guide roller 211 and the fourth guide roller 219 between the black and red platen rollers 112 and 122 and the black and red printing heads 410 and 420. Here, the fourth guide roller 219 is also attached to a motor (not shown) controlled by the motor control unit 310 such that the moving speed of the loop shaped second film member 201 is in agreement with the roll out speed of the first black film member 110 and the first red film member 120.

In addition, the thermal printer of this second embodiment should preferably be equipped with a cleaning device (not shown) either between the driving roller 217 and the third guide roller 218 or between the third and fourth guide rollers 218 and 219, for cleaning the loop shaped second film member 201 to remove the dusts from a side of the loop shaped second film member 201 for receiving the black carbon C1 and the red carbon C2.

According to this second embodiment, the loop shaped second film member 201 can be used in circulation, so that there is no need to exchange a used second film member with a new second film member as required in the first embodiment, and a cost and a time required for such an exchange operation can be saved, in addition to all the effects of the first embodiment as described above.

Referring now to Fig. 3, a third embodiment of a thermal transfer type printing apparatus according to the present invention will be described in detail. Here, those elements which are substantially identical to the corresponding elements in the first embodiment of Fig. 1 described above will be given the same reference numerals in the figure, and their description will be omitted.

This third embodiment of Fig. 3 differs from the first embodiment of Fig. 1 described above in that a mechanism for temporarily pooling a plurality of desired printing patterns formed on the second printing member 200 is incorporated in a form of a movable roller 221, and a thermal transfer roller 501 replaces the thermal transfer roller 500 of the first embodiment.

Namely, the second film member 200 guided between the black and red platen rollers 112 and 122 and the black and red printing heads 410 and 420 from the second roll out reel 210 to the first

guide roller 211 is then guided through the movable roller 221 and the thermal transfer roller 501, and then rolled up by the second roll up reel 213.

The movable roller 221 is movable in a direction of moving toward or moving away with respect to the cardboard A, such that a distance that the second film member 200 passes between the first guide roller 211 and the thermal transfer roller 501 can be changed. This movable roller 221 is moved away from the cardboard A while the black and red printing heads 410 and 420 are carrying out the heating operations for forming the desired printing patterns on the second film member 200, so as to temporarily pool portions of the second film member 200 having a plurality of desired printing patterns formed thereon. Then, after a prescribed amount of the desired printing patterns are pooled, this movable roller 221 is moved toward the cardboard A such that the temporarily pooled portions of the second film member 200 having a plurality of desired printing patterns formed thereon are sequentially fed into the thermal transfer printing position of the thermal transfer roller 501 as the second film member 200 is rolled up by the second roll up reel 213.

The thermal transfer roller 501 is also movable in a direction of moving toward or moving away with respect to the cardboard A, and at a time of the thermal transfer of the desired printing patterns from the second film member 200 to the cardboard A, the thermal transfer roller 501 is moved toward the cardboard A to press the second film member 200 against the cardboard A while being rotated by the second film member 200 as the second film member 200 is rolled up by the second roll up reel 213. Here, the second roll up reel 213 is controlled by the motor control unit 310 to roll up the second film member 200 at the same speed as the feeding speed of the cardboard A by the belt conveyer B.

Now, the operation of this thermal printer of Fig. 3 will be described.

As the printing operation starts, the command signal for the desired printing pattern is supplied from the printer control unit 300 to the black printing controller 411 and the red printing controller 421, and in response to this command signal, the black and red portions of the desired printing pattern by the carbon black C1 and the carbon red C2 are formed on the second film member 200 by the black printing head 410 and the red printing head 420, respectively, just as in the first embodiment described above. During this heating operations by the black and red printing heads 410 and 420, the movable roller 221 is moved away from the cardboard A, so as to temporarily pool portions of the second film member 200 having a plurality of desired printing patterns formed thereon. Then, when a prescribed amount of the desired printing patterns are pooled by this movable roller 221, the heating operations by the black and red printing heads 410 and 420 are stopped and a printing start signal is issued.

In response to this printing start signal, the cardboard A to be printed is conveyed by the belt conveyer B into the thermal transfer printing position of the thermal transfer roller 501. Then, the thermal transfer roller 501 is moved toward the cardboard A to press the second film member 200 against the cardboard A and rotated by the second film member 200 as the second film member 200 is rolled up by the second roll up reel 213, while the movable roller 221 is moved toward the cardboard A such that the temporarily pooled portions of the second film member 200 having a plurality of desired printing patterns are sequentially fed into the thermal transfer printing position of the thermal transfer roller 501.

During this thermal transfer printing operation by the thermal transfer roller 501, the belt conveyer B continues to move a number of cardboards A sequentially at the same speed as the roll up speed of the second film member 200 by the second roll up reel 213, such that the second film member 200 and each cardboard A move together to print one part of the desired printing patterns from the temporarily pooled portions of the second film member 200 onto the surface of the cardboard A sequentially.

After this thermal transfer printing operation is completed for one of the cardboards A, the thermal transfer roller 501 is moved away from this cardboard A and the rolling up of the second film member 200 by the second roll up reel 213 is stopped while this cardboard A with the desired printing patterns printed thereon is conveyed out from the thermal printer by the belt conveyer B, and a new cardboard A to be printed next is conveyed into a thermal transfer printing position in the thermal printer. Then, the thermal transfer roller 501 is moved toward the new cardboard A gain to press the second film member 200 against the new cardboard A and rotated by the second film member 200 as the second film member 200 is rolled up by the second roll up reel 213, to print another part of the desired printing patterns from the temporarily pooled portions of the second film member 200 onto the surface of the new cardboard A sequentially.

In this manner, the printing of a plurality of desired printing patterns from the temporarily pooled portions of the second film member 200 is carried out sequentially as the movable roller 221 is moved toward the cardboard A such that the temporarily pooled portions of the second film member 200 having a plurality of desired printing patterns are sequentially fed into the thermal trans-

fer printing position of the thermal transfer roller 501. Also, during this printing of a plurality of desired printing patterns from the temporarily pooled portions of the second film member 200, the heating operations by the black and red printing heads 410 and 420 can be resumed for the next desired printing patterns.

According to this third embodiment, the desired printing patterns can be pooled on the temporarily pooled portions of the second film member 200, so that the speed of the desired printing pattern formation per unit time can be increased. Also, the printing from the temporarily pooled portions of the second film member 200 can be made at the same speed as the feeding speed of the cardboard A, so that by increasing the feeding speed of the cardboard A, it also becomes possible to increase a rate of printing of the desired printing patterns per unit time, such that the interval between the successive printing operations can be reduced and therefore the sequential printing of a plurality of printing patterns can be made at a high speed, in addition to all the effects of the first embodiment as described above.

Referring now to Fig. 4, a fourth embodiment of a thermal transfer type printing apparatus according to the present invention will be described in detail. Here, those elements which are substantially identical to the corresponding elements in the third embodiment of Fig. 3 described above will be given the same reference numerals in the figure, and their description will be omitted.

This fourth embodiment of Fig. 4 differs from the third embodiment of Fig. 3 described above in that a loop shaped second film member 201 is used instead of the second film member 200. In conjunction with this loop shaped second film member 201, the thermal printer is equipped with a driving roller 217 replacing the second guide roller 212 of the first embodiment, third and fourth guide rollers 218 and 219 replacing the second roll out reel 210 and the second roll up reel 213 of the first embodiment, and a tension roller 220 located between the driving roller 217 and the third guide roller 218 for applying a prescribed tension to the loop shaped second film member 201, just as in the second embodiment of Fig. 2 described above. Thus, this fourth embodiment is effectively a hybrid of the second embodiment of Fig. 2 and the third embodiment of Fig. 3.

In this configuration of Fig. 4, the loop shaped second film member 201 is guided by first guide roller 211 and the driving roller 217 to have its one side which received the black carbon C1 and the red carbon C2 to be parallelly facing toward the surface of the cardboard A, and then wound around the third and fourth guide rollers 218 and 219 to circulate through a rectangular path.

The driving roller 217 is attached to a driving motor (not shown) controlled by the motor control unit 310 such that the moving speed of the loop shaped second film member 201 is in agreement with the feeding speed of the cardboard A by the belt conveyer B.

The loop shaped second film member 201 is also guided by first guide roller 211 and the fourth guide roller 219 between the black and red platen rollers 112 and 122 and the black and red printing heads 410 and 420. Here, the fourth guide roller 219 is also attached to a motor (not shown) controlled by the motor control unit 310 such that the moving speed of the loop shaped second film member 201 is in agreement with the roll out speed of the first black film member 110 and the first red film member 120.

In addition, the thermal printer of this fourth embodiment should preferably be equipped with a cleaning device (not shown) either between the driving roller 217 and the third guide roller 218 or between the third and fourth guide rollers 218 and 219, for cleaning the loop shaped second film member 201 to remove the dusts from a side of the loop shaped second film member 201 for receiving the black carbon C1 and the red carbon C2.

Also, in this fourth embodiment, the tension roller 220 has a large motion stroke in order to be able to account for the motion of the movable roller 221.

According to this fourth embodiment, the loop shaped second film member 201 can be used in circulation, so that there is no need to exchange a used second film member with a new second film member as required in th third embodiment, and a cost and a time required for such an exchange operation can be saved, in addition to all the effects of the third embodiment as described above.

Referring now to Fig. 5, a fifth embodiment of a thermal transfer type printing apparatus according to the present invention will be described in detail. Here, those elements which are substantially identical to the corresponding elements in the first and third embodiments of Figs. 1 and 3 described above will be given the same reference numerals in the figure, and their description will be omitted.

This fifth embodiment of Fig. 5 is effectively a hybrid of the first embodiment of Fig. 1 and the third embodiment of Fig. 3.

Namely, in this fifth embodiment, a mechanism for temporarily pooling a plurality of desired printing patterns formed on the second printing member 200 is incorporated into the configuration of Fig. 1 in a form of a movable roller 221. Thus, the second film member 200 rolled out from the second roll out reel 210 and guided between the black and red platen rollers 112 and 122 and the black

and red printing heads 410 and 420 from the second roll out reel 210 to the first guide roller 211 is then guided through the movable roller 221. Then, the second film member 200 is guided by fifth and second guide rollers 216 and 212 to have its one side which received the black carbon C1 and the red carbon C2 to be parallelly facing toward the surface of the cardboard A conveyed on a belt conveyer B, and rolled up by the second roll up reel 213.

In addition, there is provided a stopper member 700 for stopping the motion of the second film member 200 through the fifth guide roller 216 by pinching the second film member 200 between this stopper member 700 and the fifth guide roller 216.

The motor control unit 310 controls the second roll out reel 210 such that the roll out speed of the second film member 200 is in agreement with the roll out speed of the first black film member 110 and the first red film member 120, while controlling the second roll up reel 213 to roll up the second film member 200 at a speed independent from the roll out speed of the second film member 200.

The thermal transfer roller 500, which is movable in a direction along the second film member 200 as well as in a direction of moving toward or moving away from the second film member 200, is provided between the fifth guide roller 216 and the second guide roller 212.

In this fifth embodiment, as the black and red portions of the desired printing pattern by the carbon black C1 and the carbon red C2 are formed on the second film member 200 by the black printing head 410 and the red printing head 420, respectively, the movable roller 221 is moved away from the cardboard A, so as to temporarily pool portions of the second film member 200 having a plurality of desired printing patterns formed thereon.

Then, the temporarily pooled portions of the second film member 200 are sequentially fed into the thermal transfer printing position of the thermal transfer roller 500 over the cardboard A as the second film member 200 is rolled up by the second roll up reel 213. When an appropriate part of the temporarily pooled portions of the second film member 200 is placed in the thermal transfer printing position, the roll up of the second film member 200 by the second roll up reel 213 is stopped, and the stopper member 700 is moved toward the fifth guide roller 216 to pinch the second film member 200 therebetween. As a result, the second film member 200 is fixed at the fifth guide roller 216 and the appropriate part of the temporarily pooled portions of the second film member 200 is set in a state of being stretched between the fifth and second guide rollers 216 and 212.

Then, the thermal transfer roller 500 is moved toward the cardboard A to press the second film member 200 against the cardboard A and then moved along the second film member 200 from the fifth guide roller 216 side to the second guide roller 212 side. As a result, the appropriate part of the desired printing patterns formed on the second film member 200 is thermally transferred onto the surface of the cardboard A. After this thermal transfer of the desired printing pattern is finished, the thermal transfer roller 500 is moved away from the second film member 200 such that the second film member 200 is separated from the cardboard A.

When this thermal transfer printing operation is completed for one of the cardboards A, this cardboard A with the desired printing patterns printed thereon is conveyed out from the thermal printer by the belt conveyer B, and a new cardboard A to be printed next is conveyed into a thermal transfer printing position in the thermal printer, and the thermal transfer printing operation similar to that described above is carried out for this new cardboard A.

In this manner, the printing of a plurality of desired printing patterns from the temporarily pooled portions of the second film member 200 is carried out sequentially as the movable roller 221 is moved toward the cardboard A such that the temporarily pooled portions of the second film member 200 having a plurality of desired printing patterns are sequentially fed into the thermal transfer printing position of the thermal transfer roller 500. Also, during this printing of a plurality of desired printing patterns from the temporarily pooled portions of the second film member 200, the heating operations by the black and red printing heads 410 and 420 can be resumed for the next desired printing patterns.

Here, in a case the speed of forming the desired printing patterns on the second film member 200 is faster than the speed of printing the desired printing patterns from the temporarily pooled portions of the second film member 200, the heating operations by the black and red printing heads 410 and 420 are stopped when an amount of the desired printing patterns pooled by this movable roller 221 reaches to a prescribed amount,

Thus, according to this fifth embodiment, all the effects of the first and third embodiments as described above can be achieved together.

Referring now to Fig. 6, a sixth embodiment of a thermal transfer type printing apparatus according to the present invention will be described in detail. Here, those elements which are substantially identical to the corresponding elements in the fifth embodiment of Fig. 5 described above will be given the same reference numerals in the figure, and their description will be omitted.

This sixth embodiment of Fig. 6 differs from the fifth embodiment of Fig. 5 described above in

that a loop shaped second film member 201 is used instead of the second film member 200. In conjunction with this loop shaped second film member 201, the thermal printer is equipped with a driving roller 217 replacing the second guide roller 212 of the first embodiment, third and fourth guide rollers 218 and 219 replacing the second roll out reel 210 and the second roll up reel 213 of the first embodiment, and a tension roller 220 located between the driving roller 217 and the third guide roller 218 for applying a prescribed tension to the loop shaped second film member 201, just as in the second embodiment of Fig. 2 described above. Thus, this sixth embodiment is effectively a hybrid of the second embodiment of Fig. 2 and the fourth embodiment of Fig. 4.

In this configuration of Fig. 6, the loop shaped second film member 201 is guided by fifth guide roller 216 and the driving roller 217 to have its one side which received the black carbon C1 and the red carbon C2 to be parallelly facing toward the surface of the cardboard A, and then wound around the third and fourth guide rollers 218 and 219 to circulate through a rectangular path.

The driving roller 217 is attached to a driving motor (not shown) controlled by the motor control unit 310 such that the moving speed of the loop shaped second film member 201 is controlled independently from the roll out speed of the first black and red film members 110 and 120.

Thus, according to this sixth embodiment, all the effects of the second and fourth embodiments as described above can be achieved together.

Referring now to Figs. 7 to 12, modified configurations for the above described first to sixth embodiments will be described. Here, those elements which are substantially identical to the corresponding elements in the first to sixth embodiments described above will be given the same reference numerals in the figure, and their description will be omitted.

First, Fig. 7 shows a modified configuration for the first embodiment of Fig. 1 described above, which differs from the configuration of Fig. 1 in that: each of the motor shafts 114, 124, and 214 to which the first black roll out reel 111, the first red roll out reel 121, and the second roll out reel 210 are attached, respectively, is replaced by a braking shaft not connected with a motor; the black and red platen rollers 112 and 122 are attached to black and red driving shafts 610 and 620 of stepping motors, respectively; and each of the first black roll up motor shaft 115, the first red roll up motor shaft 125, and the second roll up motor shaft 215 is driven by a torque motor.

In this modified configuration of Fig. 7, the braking shafts 114, 124, and 214 provide an appropriate braking due to a prescribed torque to the first black roll out reel 111, the first red roll out reel 121, and the second roll out reel 210, respectively, such that the first black film member 110, the first red film member 120, and the second film member 200 can be rolled out smoothly at a constant tension.

The stepping motors connected to the black and red driving shafts 610 and 620 are controlled by the motor control unit 310 to be synchronized with each other completely, such that the first black film member 110, the first red film member 120, and the second film member 200 can be rolled out from the first black roll out reel 111, the first red roll out reel 121, and the second roll out reel 210 for the identical amount simultaneously.

The torque motors connected to the first black and red roll up motor shafts 115 and 125 and the second roll up motor shaft 215 are controlled by the motor control unit 310 to drive the first black roll up reel 113, the first red roll up reel 123, and the second roll up reel 213 such that the first black film member 110, the first red film member 120, and the second film member 200 can be drawn out from the black and red platen rollers 112 and 122 without any sagging.

The rest of this modified configuration of Fig. 7 is substantially equivalent to that of Fig. 1.

Next, Fig. 8 shows a modified configuration for the second embodiment of Fig. 2 described above, which differs from the configuration of Fig. 2 in that: each of the motor shafts 114 and 124 to which the first black roll out reel 111 and the first red roll out reel 121 are attached, respectively, is replaced by a braking shaft not connected with a motor; the black and red platen rollers 112 and 122 are attached to black and red driving shafts 610 and 620 of stepping motors, respectively; each of the first black roll up motor shaft 115 and the first red roll up motor shaft 125 is driven by a torque motor; and the driving roller 217 and the fourth guide roller 219 are made to be not connected with a motor and freely rotatable.

In this modified configuration of Fig. 8, the braking shafts 114 and 124, the stepping motors connected to the black and red driving shafts 610 and 620, and the torque motors connected to the first black and red roll up motor shafts 115 and 125 are substantially similar to those in the modified configuration of Fig. 7 described above.

The driving roller 217 and the fourth guide roller 219 only functions to guide the loop shaped second film member 201 by freely rotating. Here, however, for the purpose of pushing the moving loop shaped second film member 201 or moving the stopping loop shaped second film member 201, the driving roller 217 and the fourth guide roller 219 may be connected with motors as in the configuration of Fig. 2.

The rest of this modified configuration of Fig. 8 is substantially equivalent to that of Fig. 2.

Next, Fig. 9 shows a modified configuration for the third embodiment of Fig. 3 described above, which differs from the configuration of Fig. 3 in that: each of the motor shafts 114, 124, and 214 to which the first black roll out reel 111, the first red roll out reel 121, and the second roll out reel 210 are attached, respectively, is replaced by a braking shaft not connected with a motor; the black and red platen rollers 112 and 122 are attached to black and red driving shafts 610 and 620 of stepping motors, respectively; and each of the first black roll up motor shaft 115, the first red roll up motor shaft 125, and the second roll up motor shaft 215 is driven by a torque motor. These changes are substantially similar to those in the modified configuration of Fig. 7 described above.

The rest of this modified configuration of Fig. 9 is substantially equivalent to that of Fig. 3.

Next, Fig. 10 shows a modified configuration for the fourth embodiment of Fig. 4 described above, which differs from the configuration of Fig. 4 in that: each of the motor shafts 114 and 124 to which the first black roll out reel 111 and the first red roll out reel 121, are attached, respectively, is replaced by a braking shaft not connected with a motor; the black and red platen rollers 112 and 122 are attached to black and red driving shafts 610 and 620 of stepping motors, respectively; each of the first black roll up motor shaft 115 and the first red roll up motor shaft 125 is driven by a torque motor; and the fourth guide roller 219 is made to be not connected with a motor and freely rotatable. These changes are substantially similar to those in the modified configuration of Fig. 8 described above.

The rest of this modified configuration of Fig. 10 is substantially equivalent to that of Fig. 4.

Next, Fig. 11 shows a modified configuration for the fifth embodiment of Fig. 5 described above, which differs from the configuration of Fig. 5 in that: each of the motor shafts 114, 124, and 214 to which the first black roll out reel 111, the first red roll out reel 121, and the second roll out reel 210 are attached, respectively, is replaced by a braking shaft not connected with a motor; the black and red platen rollers 112 and 122 are attached to black and red driving shafts 610 and 620 of stepping motors, respectively; and each of the first black roll up motor shaft 115, the first red roll up motor shaft 125, and the second roll up motor shaft 215 is driven by a torque motor. These changes are substantially similar to those in the modified configuration of Fig. 7 described above.

The rest of this modified configuration of Fig. 11 is substantially equivalent to that of Fig. 5.

Next, Fig. 12 shows a modified configuration for the sixth embodiment of Fig. 6 described above, which differs from the configuration of Fig. 6 in that: each of the motor shafts 114 and 124 to which the first black roll out reel 111 and the first red roll out reel 121, are attached, respectively, is replaced by a braking shaft not connected with a motor; the black and red platen rollers 112 and 122 are attached to black and red driving shafts 610 and 620 of stepping motors, respectively; each of the first black roll up motor shaft 115 and the first red roll up motor shaft 125 is driven by a torque motor; and the fourth guide roller 219 is made to be not connected with a motor and freely rotatable. These changes are substantially similar to those in the modified configuration of Fig. 8 described above.

The rest of this modified configuration of Fig. 12 is substantially equivalent to that of Fig. 6.

It is to be noted here that each of the first to six embodiments described above may be further modified to change the number of first film members to just one for the monochromatic printing, or to more than two for the multi-color printing using more than two colors. It should be obvious that, in a case of increasing the number of first film members, the corresponding platen roller and the printing head as well as elements associated with them must also be added accordingly.

It is also to be noted here that the first to six embodiments described above are not only applicable to the printing target in a form of the cardboard A as described above, but also applicable to the other printing targets such as a box shaped cardboard, an object made of wood or iron, etc. In addition, the surface of the printing target may not necessarily be a flat surface, and can be a curved surface such as that of a cylindrical printing target.

It is also to be noted that, in the first, second, fifth and sixth embodiments described above, the thermal transfer roller 500 should preferably be moved along the second film member 200 or 201 in opposite directions in two successive thermal transfer printing operations, in such a manner that the thermal transfer roller 500 is moved alternately from the first guide roller 211 side or the fifth guide roller 216 side to the second guide roller 212 side or the driving roller 217 side for one thermal transfer printing operation, and from the second guide roller 212 side or the driving roller 217 side to the first guide roller 211 side or the fifth guide roller 216 side for next thermal transfer printing, and so on.

It is also to be noted that, in the third and fourth embodiments described above, the movable roller 221 may be made to be movable in any direction other than a direction perpendicular to the

cardboard A as shown in Figs. 3 and 4, so long as it is possible to temporarily pool some portions of the second film member 200 or 201.

Referring now to Figs. 13 and 14, a seventh embodiment of a thermal transfer type printing apparatus according to the present invention will be described in detail.

This thermal printer of Fig. 13 includes a first black film member 710, a first red film member 720, and a second film member 800. The first black film member 710 carries on one side a carbon black C1 as a thermally transferrable applied material for printing, while the first red film member 720 carries on one side a carbon red C2 as a thermally transferrable applied material for printing. On the other hand, the second film member 800 carries no applied material initially, and receives the carbon black C1 and the carbon red C2 thermally transferred from the first black film member 710 and the first red film member 720.

The first black film member 710 and the first red film member 720 are initially provided inside a printer body in a state of being rolled up on cartridge type first black roll out reel 711 and first red roll out reel 721, respectively. Then, the first black film member 710 is rolled out with the carbon black C1 facing inwards, guided into a vicinity of a platen roller 900 by a plurality of guide rollers 712 and a black printing head 713 located around the platen roller 900, and rolled up by a first black roll up reel 714. Similarly, the first red film member 720 is rolled out with the carbon red C2 facing inwards, guided into a vicinity of the platen roller 900 by a plurality of guide rollers 722 and a red printing head 723 located around the platen roller 900, and rolled up by a first black roll up reel 724.

The first black roll out reel 711 and the first red roll out reel 721 are detachably attached to a first black roll out motor shaft 715 and a first red roll out motor shaft 725, respectively, each of which is connected with a braking motor (not shown) for generating a prescribed braking torque to provide a constant tension to the respective one of the first black film member 710 and the first red film member 720.

The first black roll up reel 714 and the first red roll up reel 724 are detachably attached to a first black roll up motor shaft 716 and a first red roll up motor shaft 726, respectively, each of which is connected with a torque motor (not shown) for rolling up the respective one of the first black film member 710 and the first red film member 720 at a constant tension.

The second film member 800 is initially provided inside a printer body in a state of being rolled up on a cartridge type second roll out reel 810. Then, the second film member 800 is rolled out from this second roll out reel 810, guided by a plurality of guide rollers 811 and a feed forward roller 812 to the platen roller 900 around which it is wound, guided by printing guide rollers 813 to have its one side which received the black carbon C1 and the red carbon C2 to be parallelly facing toward a surface of a printing target in a form of a cardboard A, and rolled up by a second roll up reel 214.

The second roll out reel 810 is detachably attached to a second roll out motor shaft 815 connected with a braking motor (not shown) for generating a prescribed braking torque to provide a constant tension to the second film member 800. The feed forward roller 812 operates to feed the second film member 800 at a high speed. The second roll up reel 816 is detachably attached to a second roll up motor shaft 816 connected with a torque motor (not shown) for rolling up the second film member 800 at a constant tension.

The platen roller 900 is attached to a stepping motor 901 as shown in Fig. 14, and controls the motion of the second film member 900 around this platen roller 900 accurately.

Each of the black printing head 713 and the red printing head 723 is equipped with a multiplicity of dot shaped heat generating resistor elements, and an amount of current flowing through each of these heat generating resistor elements is controlled by a black printing controller (not shown) and a red printing controller (not shown), respectively.

As shown in detail in Fig. 14, the black printing head 713 is located around the platen roller 900 at an upper stream side of the second film member 800, while the red printing head 723 is located around the platen roller 900 at a lower stream side of the second film member 800. Each of the black and red printing heads 713 and 723 is made to be pivotable about a fixed end by means of a spring 920 and an air cylinder 940, such that a free end can be moved toward or away from the platen roller 900 by this pivotal motion.

The spring 920 draws the free end of the respective one of the black and red printing heads 713 and 723 toward the platen roller 900 such that the respective one of the first black and red film members 710 and 720 is pressed against the second film member 800 wound around the platen roller 900 by a constant force. Here, the drawing force exerted by the spring 920 can be adjusted by means of an adjustment bolt 930 attached to the spring 920. On the other hand, the air cylinder 940 pulls the free end of the respective one of the black and red printing heads 713 and 723 away from the platen roller 900.

In this seventh embodiment, the black printing head 713 and the red printing head 723 are controlled to thermally transfer the portions of the

carbon black C1 and the carbon red C2 on the first black film member 710 and the first red film member 720 that are necessary for forming a desired printing pattern to be printed on the second film member 800.

Except for a time of the thermal transfer described above, the black printing head 713 and the red printing head 723 are moved away from the platen roller 900, and while the black printing head 713 and the red printing head 723 are located away from the platen roller 900, the first black film member 710 and the first red film member 720 are not rolled up.

Between the printing guide rollers 813, there is provided a thermal transfer roller 910, which is movable in a direction along the second film member 800 as well as in a direction of moving toward or moving away from the second film member 800.

At a time of the thermal transfer of the desired printing pattern from the second film member 800 to the cardboard A, the thermal transfer roller 910 is moved toward the second film member 800 to press the second film member 800 against the cardboard A while heating the second film member 800, and rolls along the second film member 800 between the printing guide rollers 813, to print the entire desired printing pattern formed by the carbon black C1 and the carbon red C2 onto the cardboard A.

Here, this thermal transfer roller 910 has its surface portion formed by a soft layer with the hardness of about 30 such that the second film member 800 can be tightly pressed against the surface of the printing target even when the surface of the printing target is not smooth as in a back side surface of a corrugated cardboard. Thus, this thermal printer is capable of achieving an accurate printing even on a curved surface or a rough surface.

Also, the cardboard A is automatically conveyed into the thermal transfer printing position between the printing guide rollers 813 by means of a belt conveyer (not shown).

Now, the operation of this thermal printer of Fig. 13 will be described.

As the printing operation starts, the command signal for the desired printing pattern is supplied from a printer control unit (not shown) of the thermal printer to the black printing controller (not shown) and the red printing controller (not shown), where this command signal commands each of the black printing head 713 and the red printing head 723 to apply heat to a region in a shape of a positive mirror image of the black and red portions in the desired printing pattern, respectively, just as they are expected to appear on the cardboard A when the printing is made.

Then, the black printing head 713 is moved toward the platen roller 900 to press the second film member 800 against the first black film member 710, and the currents are supplied only to those heat generating resistor elements located within a region in the shape of the positive mirror image of the black portion in the desired printing pattern, so as to generate the heat in a region in the shape of the positive mirror image of the black portion in the desired printing pattern. Here, the platen roller 900 is accurately rotated by means of the stepping motor 901 to place the appropriate portion of the second film member 800 at the heating position of the black printing head 713.

As a result, the heat generated by the black printing head 713 is transmitted to the first black film member 710, and the carbon black C1 located within a region in the shape of the positive mirror image of the black portion in the desired black printing pattern is thermally transferred from the first black film member 710 to the second film member 800. When this thermal transfer of the carbon black C1 for the black portion in the desired printing pattern is finished, the black printing head 713 is moved away from the second film member 800 and the rolling out of the first black film member 710 is stopped.

Next, the second film member 800 is rolled by the platen roller 900 to move a region having the black portion in the desired printing pattern formed therein to the heating position of the red printing head 723.

Then, the red printing head 723 is moved toward the platen roller 900 to press the second film member 800 against the first red film member 720, and the currents are supplied only to those heat generating resistor elements located within a region in the shape of the positive mirror image of the red portion in the desired red printing pattern, so as to generate the heat in a region in the shape of the positive mirror image of the red portion in the desired printing pattern. Here, again, the platen roller 900 is accurately rotated by means of the stepping motor 901 to place the appropriate portion of the second film member 800 at the heating position of the red printing head 723.

As a result, the heat generated by the red printing head 723 is transmitted to the first red film member 720, and the carbon red C2 located within a region in the shape of the positive mirror image of the red portion in the desired red printing pattern is thermally transferred from the first red film member 720 to the second film member 800. When this thermal transfer of the carbon red C2 for the red portion in the desired printing pattern is finished, the red printing head 723 is moved away from the second film member 800 and the rolling of the first red film member 720 is stopped.

After the desired printing pattern is formed on the second film member 800 by the thermally transferred carbon black C1 and the carbon red C2 in this manner, the second film member 800 with the desired printing pattern formed thereon is moved by the platen roller 900 over the cardboard A until the desired printing pattern is placed at the thermal transfer printing position of the thermal transfer roller 910 provided over the cardboard A.

Next, the heated thermal transfer roller 910 is moved toward the second film member 800 to press the second film member 800 against the cardboard A, and then rolled along the second film member 800 between the printing guide rollers 813, from the platen roller 900 side to the second roll up reel 814 side. As a result, the desired printing pattern formed on the second film member 800 is thermally transferred onto the surface of the cardboard A, such that the positive normal image of the desired printing pattern is printed on the cardboard A. After this thermal transfer of the desired printing pattern is finished, the thermal transfer roller 910 is moved away from the second film member 800 such that the second film member 800 is separated from the cardboard A.

Then, the thermal transfer roller 910 returns back to its initial position at the platen roller 900 side, and the second film member 800 is fedforward for a prescribed amount by the feed forward roller 812 while the prescribed amount of the second film member 800 is rolled up by the second roll up reel 814.

When the printing of the desired printing pattern is finished in this manner, the cardboard A with the desired printing pattern printed thereon is conveyed out from the thermal printer by the belt conveyer (not shown), and a new cardboard A to be printed next is conveyed into a thermal transfer printing position in the thermal printer between the printing guide rollers 813. During this conveying and positioning of the previous and new cardboards A, the formation of the new desired printing pattern is carried out by the black and red printing heads 713 and 723 in the manner described above. Then, the second film member 800 with the new desired printing pattern formed thereon is moved to the thermal transfer printing position over the new cardboard A, and the printing of the new desired printing pattern onto the new cardboard A is carried out in the manner described above.

According to this seventh embodiment, the black and red printing heads 713 and 723 are located around the single common platen roller 900, so that the region of the second film member 800 on which the black portion of the desired printing pattern is thermally transferred by the black printing head 713 can be moved accurately to the heating position of the red printing head 723 by the rotation of the platen roller 900 caused by the stepping motor 901, so that the problem of the deviated coloring can be prevented almost completely.

Moreover, as only one platen roller 900 is involved, the controlling in the thermal printer can be simplified and the size of the thermal printer can be reduced.

Furthermore, as the black and red printing heads 713 and 723 are located in a close proximity from each other around the platen roller 900, the distance for which the second film member 800 is moved from the heating position of the black printing head 713 to the heating position of the red printing head 723 can be very short, and the wasteful moving of the second film member 800 becomes unnecessary and the total amount of the second film member 800 required for the printing of the entire desired printing pattern can be reduced.

In addition, the black and red portions in the desired printing pattern are formed on the same region of the second film member 800 by the black and red printing heads 713 and 723, and the black and red portions in the desired printing pattern formed on the second film member 800 are thermally transferred onto the cardboard A altogether at once by the thermal transfer roller 910, so that the thermal transfer type multi-color printing can be realized very easily at a high speed.

Moreover, unlike a conventional method which requires the black and red portions to be formed separately by two separate printers using black and red films, both of the black and red portions of the desired printing pattern can be formed in the same thermal printer, so that there is no need for the alignment of the different color portions, and therefore the highly accurate multi-color printing can be realized, by using only one thermal printer such that the cost required for the multi-color printing can also be reduced.

Also, each of the first black and red film members 710 and 720 is rolled only while the heating operation by the respective one of the black and red printing heads 713 and 723 is carried out, so that the consumption of the first black and red film members 710 and 720 can be kept at the absolutely necessary minimum level.

It is to be noted here that this seventh embodiment may be further modified to change the number of first film members and the number of the printing heads provided around the platen roller 900 to more than two for the multi-color printing using more than two colors. It is also possible to provide more than one of the platen rollers similar to the platen roller 900 described above around which more than one printing heads are located.

It is also to be noted here that the seventh embodiment described above are not only applicable to the printing target in a form of the cardboard A as described above, but also applicable to the other printing targets such as a box shaped cardboard, an object made of wood or iron, etc. In addition, the surface of the printing target may not necessarily be a flat surface, and can be a curved surface such as that of a cylindrical printing target.

It is also to be noted that, in the embodiment described above, the thermal transfer roller 910 can be moved along the second film member 800 in opposite directions in two successive thermal transfer printing operations, in such a manner that the thermal transfer roller 910 is moved alternately from the platen roller 900 side to the second roll up reel 814 side for one thermal transfer printing operation, and from the second roll up reel 814 side to the platen roller 900 side for next thermal transfer printing, and so on.

It is finally to be noted that, besides those already mentioned above, many modifications and variations of the above embodiments may be made without departing from the novel and advantageous features of the present invention. Accordingly, all such modifications and variations are intended to be included within the scope of the appended claims.

Claims

1. An apparatus for thermal transfer type printing, comprising:

first film means for carrying a thermally transferrable applied material;

second film means for receiving the applied material thermally transferred from the first film means;

printing pattern formation means for forming a desired printing pattern on the second film means by applying heat from the second printing means side to a desired part of the applied material on the first film means in a shape of the desired printing pattern; and

thermal transfer means for thermally transferring the desired printing pattern formed on the second film means to a printing target.

2. The apparatus of claim 1, further comprising:

first film moving means for moving the first film means through a heating position of the printing pattern formation means;

second film moving means for moving the second film means through the heating position of the printing pattern formation means and a thermal transfer position of the thermal transfer means; and

controlling means for controlling the first film moving means and the second film moving means such that the first film means and the second film means moves through the heating position of the printing pattern formation means together while the heat is applied by the printing pattern formation means, and the first film means is stopped otherwise.

3. The apparatus of claim 1, wherein the desired printing pattern formed on the second film means is a positive mirror image of the desired printing pattern resulting from an application of the heat to the desired part of the applied material on the first film means in a shape of a positive normal image of the desired printing pattern.

4. The apparatus of claim 1, wherein the second film means is in a loop shape and driven to circulate through a heating position of the printing pattern formation means and a thermal transfer position of the thermal transfer means.

5. An apparatus for thermal transfer type printing, comprising:

first film means for carrying a thermally transferrable applied material;

second film means for receiving the applied material thermally transferred from the first film means;

printing pattern formation means for forming a desired printing pattern on the second film means by applying heat to a desired part of the applied material on the first film means in a shape of the desired printing pattern;

printing pattern pooling means for temporarily pooling a plurality of desired printing patterns sequentially formed on the second film means by the printing pattern formation means, by bending a route of the second film means passing out from a heating position of the printing pattern formation means; and

thermal transfer means for thermally transferring said plurality of desired printing patterns formed on the second film means and temporarily pooled by the printing pattern pooling means to a printing target.

6. The apparatus of claim 5, wherein the printing pattern pooling means comprises a movable roller located between the printing pattern formation means and the thermal transfer means, around which the second film means passes through, and which moves to change a distance that the second film means passes between the printing pattern formation means and the thermal transfer means.

7. An apparatus for thermal transfer type printing, comprising:

a plurality of first film means for carrying thermally transferrable applied material in different colors;

second film means for receiving the applied material thermally transferred from said plurality of first film means;

printing pattern formation means for forming a plurality of desired printing patterns in said different colors on the second film means by applying heat to a desired part of the applied material on each first film means in a shape of the desired printing pattern; and

thermal transfer means for thermally transferring said plurality of desired printing patterns formed on the second film means to a printing target.

8. The apparatus of claim 7, wherein said plurality of first film means are arranged along the second film means to come into contact with the second film means one after another, within a heating position of the printing pattern formation means.

9. The apparatus of claim 8, wherein the printing pattern formation means forms said plurality of desired printing patterns on a single region of the second film means by applying heat to desired parts of the applied material on said plurality of first film means in shapes of said plurality of desired printing patterns sequentially, as the single region of the second film means comes in contact with said plurality of first film means one after another, and the thermal transfer means thermally transfers said plurality of desired printing patterns formed on the single region of the second film means to a printing target altogether at once.

10. The apparatus of claim 7, wherein the printing pattern formation means further comprises:

a plurality of printing head means located along a side of the second film means facing away from the first film means, provided in correspondence to said plurality of first film means, each printing head means applying heat from the second printing means side to a desired part of the applied material on a corresponding one of the first film means in a shape of a desired printing pattern; and

a plurality of platen roller means located along a side of the first film means facing away from the second film means, provided in correspondence to said plurality of first film means, each platen roller means being located at a position facing against a corresponding one of the printing head means across the first film means and the second film means, for supporting a corresponding one of the first film means and the second film means against the corresponding one of the printing head means.

11. The apparatus of claim 7, wherein the printing pattern formation means further comprises:

a single platen roller around which the second film means passes through; and

a plurality of printing head means located around the single platen roller, provided in correspondence to said plurality of first film means, each printing head means applying heat from the first printing means side to a desired part of the applied material on a corresponding one of the first film means in a shape of a desired printing pattern.

12. The apparatus of claim 11, further comprising a stepping motor for controlling an angle of rotation of the single platen roller between an application of heat by one of said plurality of printing head means and an application of heat by another one of said plurality of printing head means.

13. A method of thermal transfer type printing, comprising the steps of:

providing first film means for carrying a thermally transferrable applied material;

providing second film means for receiving the applied material thermally transferred from the first film means;

forming a desired printing pattern on the second film means by applying heat from the second film means side to a desired part of the applied material on the first film means in a shape of the desired printing pattern by printing pattern formation means; and

thermally transferring the desired printing pattern formed on the second film means to a printing target by thermal transfer means.

14. The method of claim 13, further comprising the steps of:

moving the first film means through a heating position of the printing pattern formation means by first film moving means;

moving the second film means through the heating position of the printing pattern formation means and a thermal transfer position of the thermal transfer means by second film moving means; and

controlling the first film moving means and the second film moving means such that the first film means and the second film means moves through the heating position of the

printing pattern formation means together while the heat is applied by the printing pattern formation means, and the first film means is stopped otherwise.

15. The method of claim 13, wherein at forming step, the desired printing pattern is formed on the second film means as a positive mirror image of the desired printing pattern resulting from an application of the heat to the desired part of the applied material on the first film means in a shape of a positive normal image of the desired printing pattern.

16. The method of claim 13, further comprising the step of forming the second film means in a loop shape and driving the second film means to circulate through a heating position of the printing pattern formation means and a thermal transfer position of the thermal transfer means.

17. A method of thermal transfer type printing, comprising the steps of:

providing first film means for carrying a thermally transferrable applied material;

providing second film means for receiving the applied material thermally transferred from the first film means;

forming a desired printing pattern on the second film means by applying heat from the second film means side to a desired part of the applied material on the first film means in a shape of the desired printing pattern by printing pattern formation means;

temporarily pooling a plurality of desired printing patterns sequentially formed on the second film means by the printing pattern formation means, by bending a route of the second film means passing out from a heating position of the printing pattern formation means; and

thermally transferring the desired printing pattern formed on the second film means to a printing target by thermal transfer means.

18. The method of claim 17, wherein at the temporarily pooling step, a bending of the route of the second film means passing out from the heating position of the printing pattern formation means is made by a movable roller located between the printing pattern formation means and the thermal transfer means, around which the second film means passes through, and which moves to change a distance that the second film means passes between the printing pattern formation means and the thermal transfer means.

19. A method of thermal transfer type printing, comprising the steps of:

providing a plurality first film means for carrying thermally transferrable applied material in different colors;

providing second film means for receiving the applied material thermally transferred from the first film means;

forming a plurality of desired printing patterns in said different colors on the second film means by applying heat to a desired part of the applied material on each first film means in a shape of the desired printing pattern by printing pattern formation means; and

thermally transferring said plurality of desired printing patterns formed on the second film means to a printing target by thermal transfer means.

20. The method of claim 19, wherein said plurality of first film means are arranged along the second film means to come into contact with the second film means one after another, within a heating position of the printing pattern formation means.

21. The method of claim 20, wherein at the forming step, the printing pattern formation means forms said plurality of desired printing patterns on a single region of the second film means by applying heat to desired parts of the applied material on said plurality of first film means in shapes of said plurality of desired printing patterns sequentially, as the single region of the second film means comes in contact with said plurality of first film means one after another, and at the thermally transferring step, the thermal transfer means thermally transfers said plurality of desired printing patterns formed on the single region of the second film means to a printing target altogether at once.

22. The method of claim 19, further comprising the step of providing the printing pattern formation means comprising:

a plurality of printing head means located along a side of the second film means facing away from the first film means, provided in correspondence to said plurality of first film means, each printing head means applying heat from the second printing means side to a desired part of the applied material on a corresponding one of the first film means in a shape of a desired printing pattern; and

a plurality of platen roller means located along a side of the first film means facing away from the second film means, provided in cor-

respondence to said plurality of first film means, each platen roller means being located at a position facing against a corresponding one of the printing head means across the first film means and the second film means, for supporting a corresponding one of the first film means and the second film means against the corresponding one of the printing head means.

23. The method of claim 19, further comprising the step of providing the printing pattern formation means comprising:

a single platen roller around which the second film means passes through; and

a plurality of printing head means located around the single platen roller, provided in correspondence to said plurality of first film means, each printing head means applying heat from the first printing means side to a desired part of the applied material on a corresponding one of the first film means in a shape of a desired printing pattern.

24. The method of claim 23, further comprising the step of controlling an angle of rotation of the single platen roller by a stepping motor between an application of heat by one of said plurality of printing head means and an application of heat by another one of said plurality of printing head means.

FIG.1

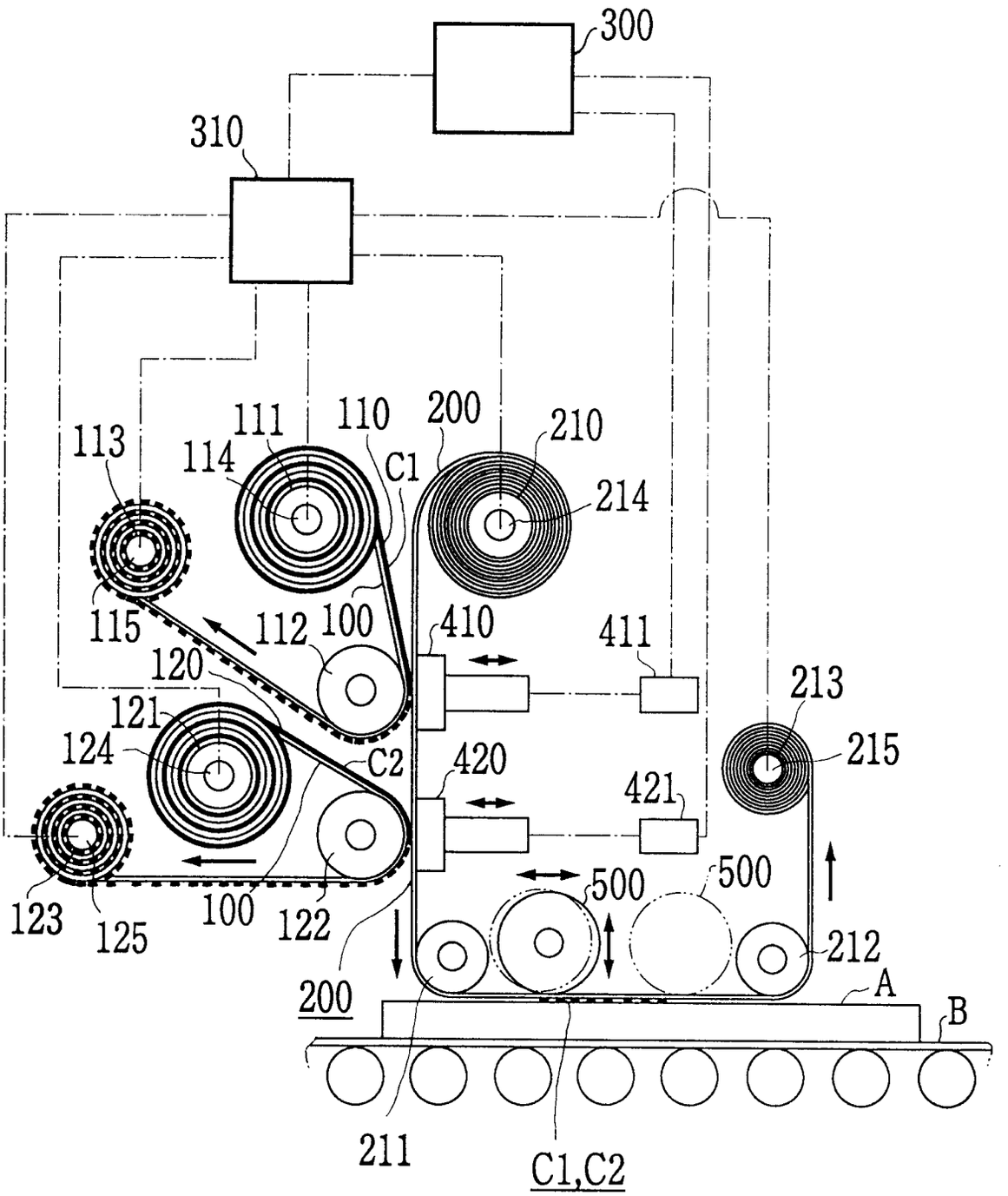
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FIG.2

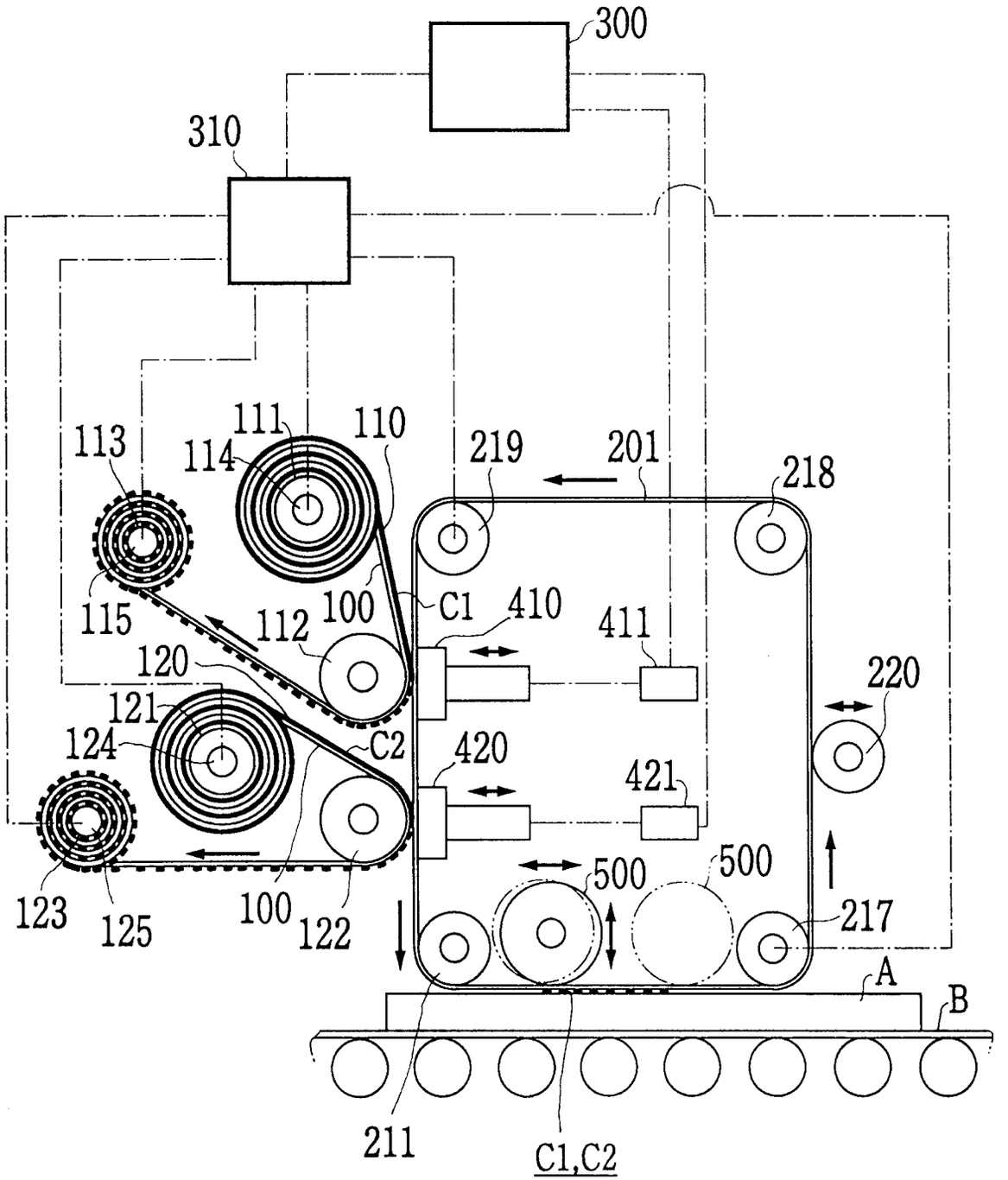
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FIG.3

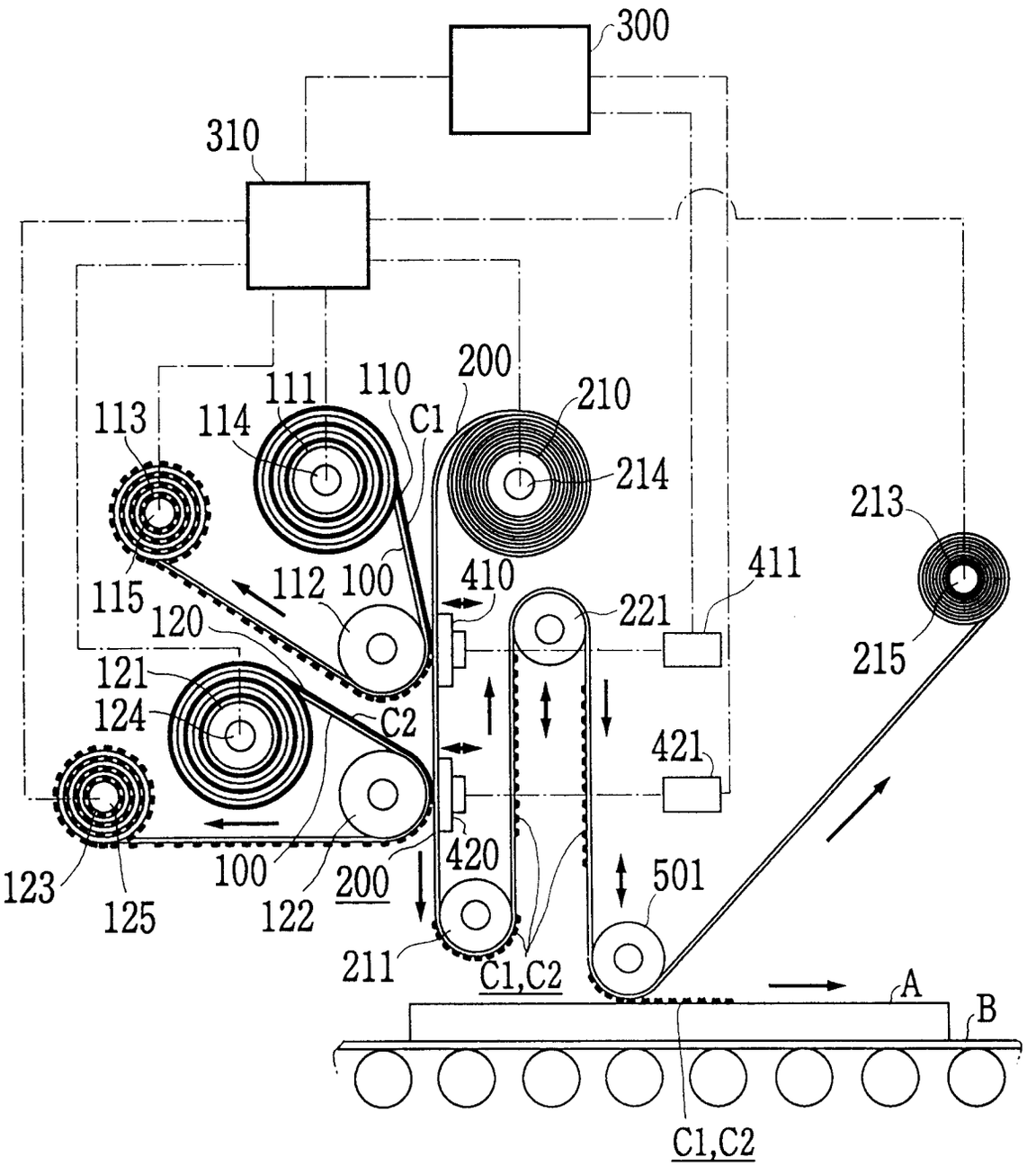
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FIG.4

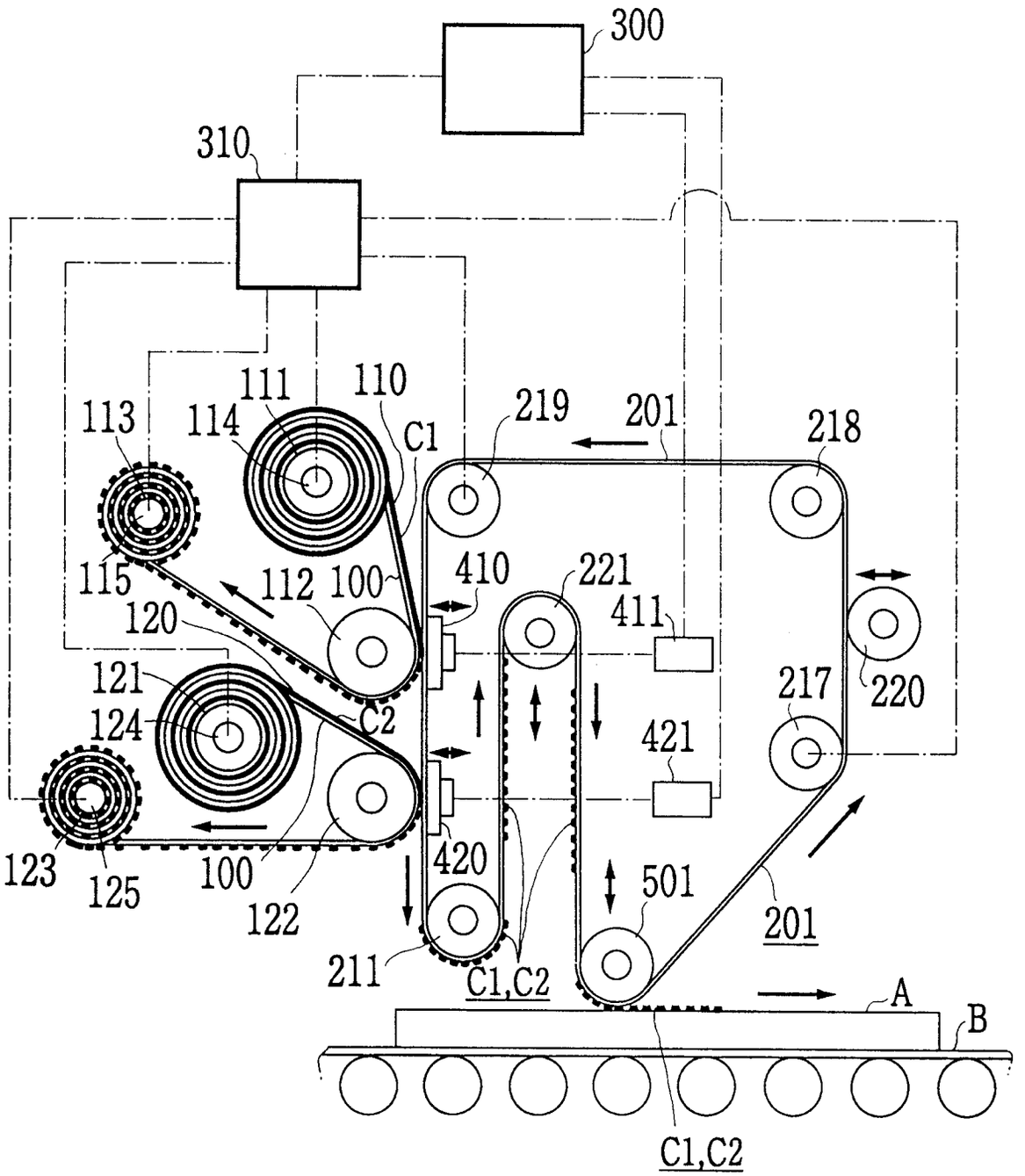
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FIG.5

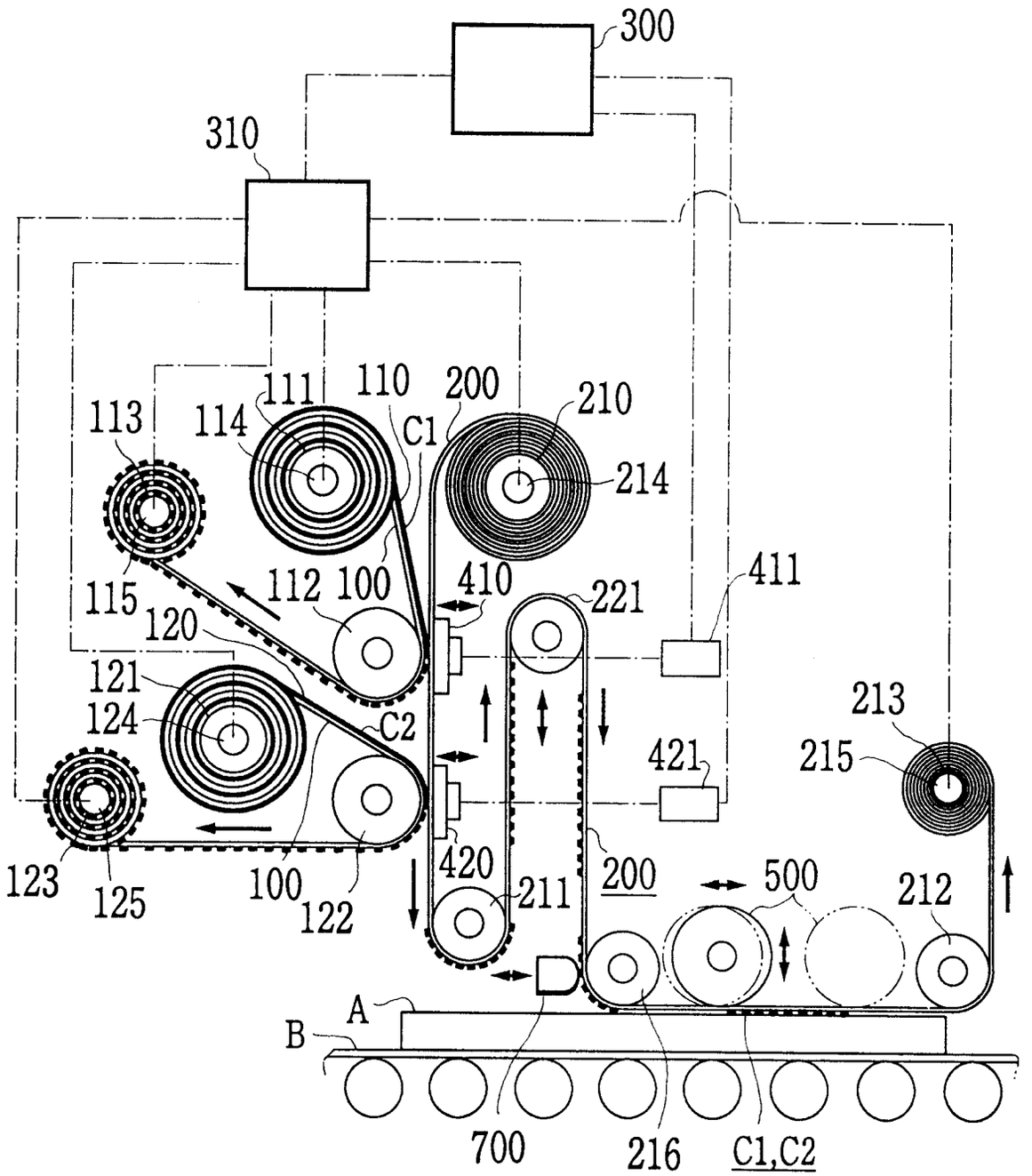
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FIG.6

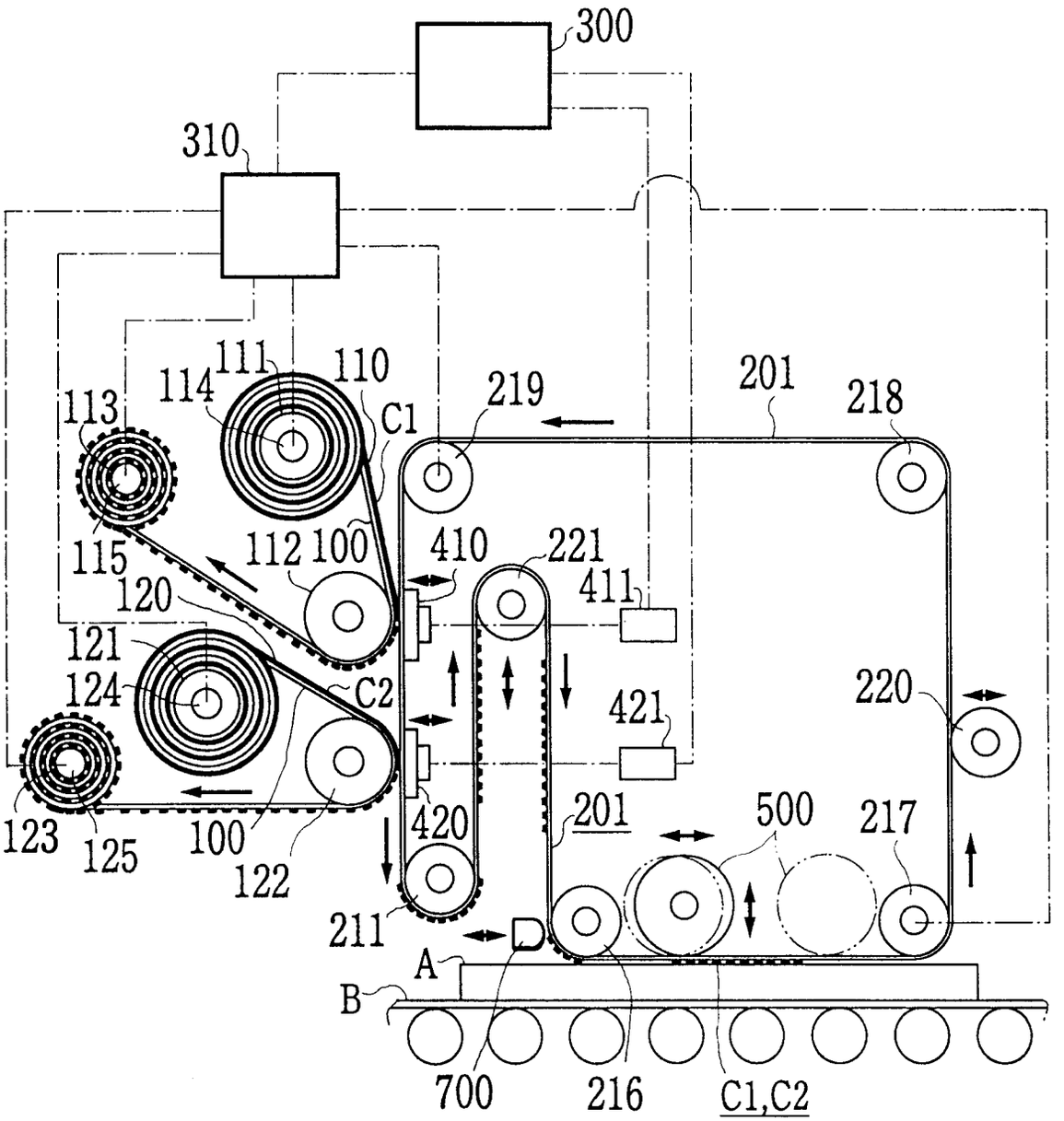
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FIG.7

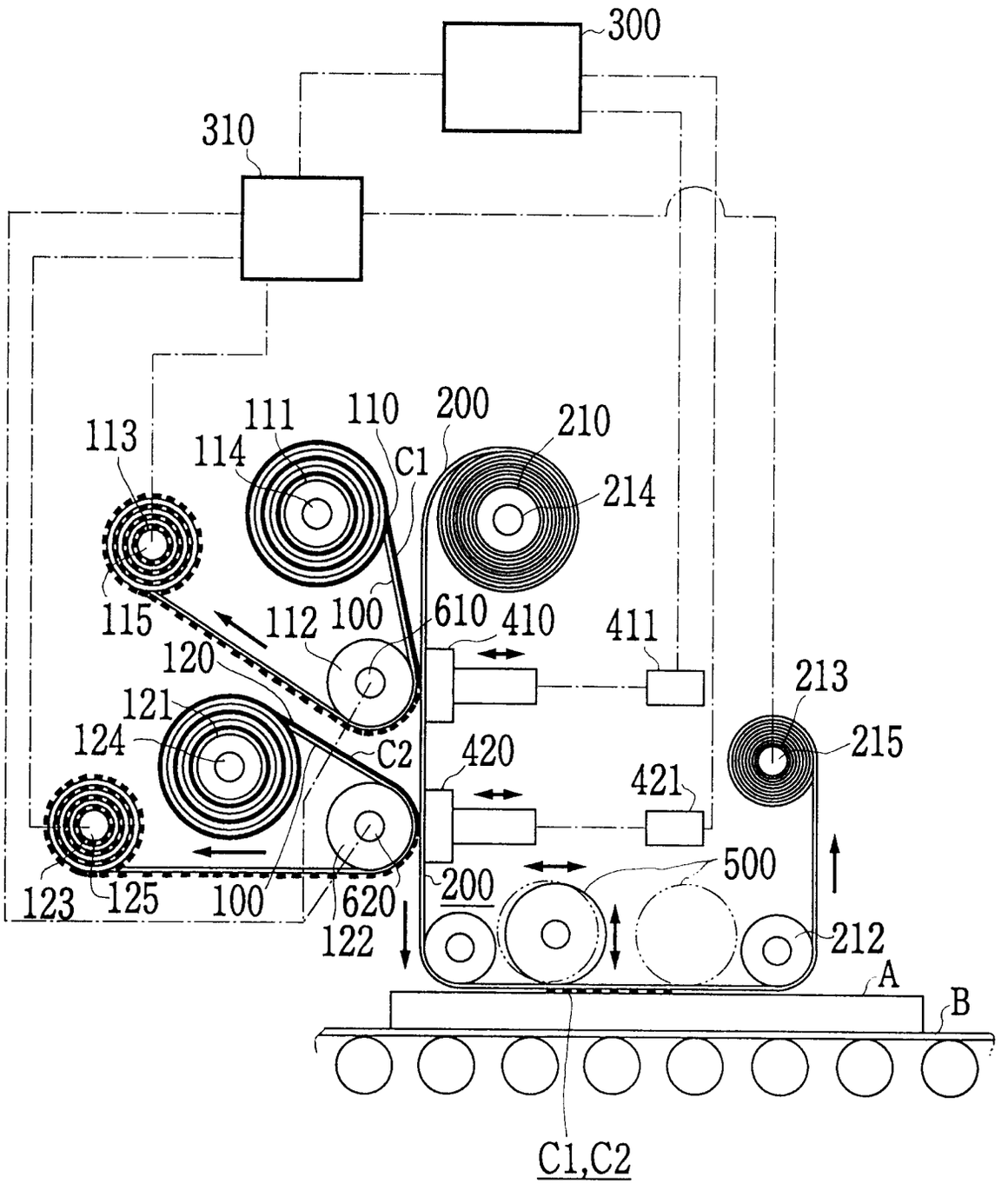
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FIG.8

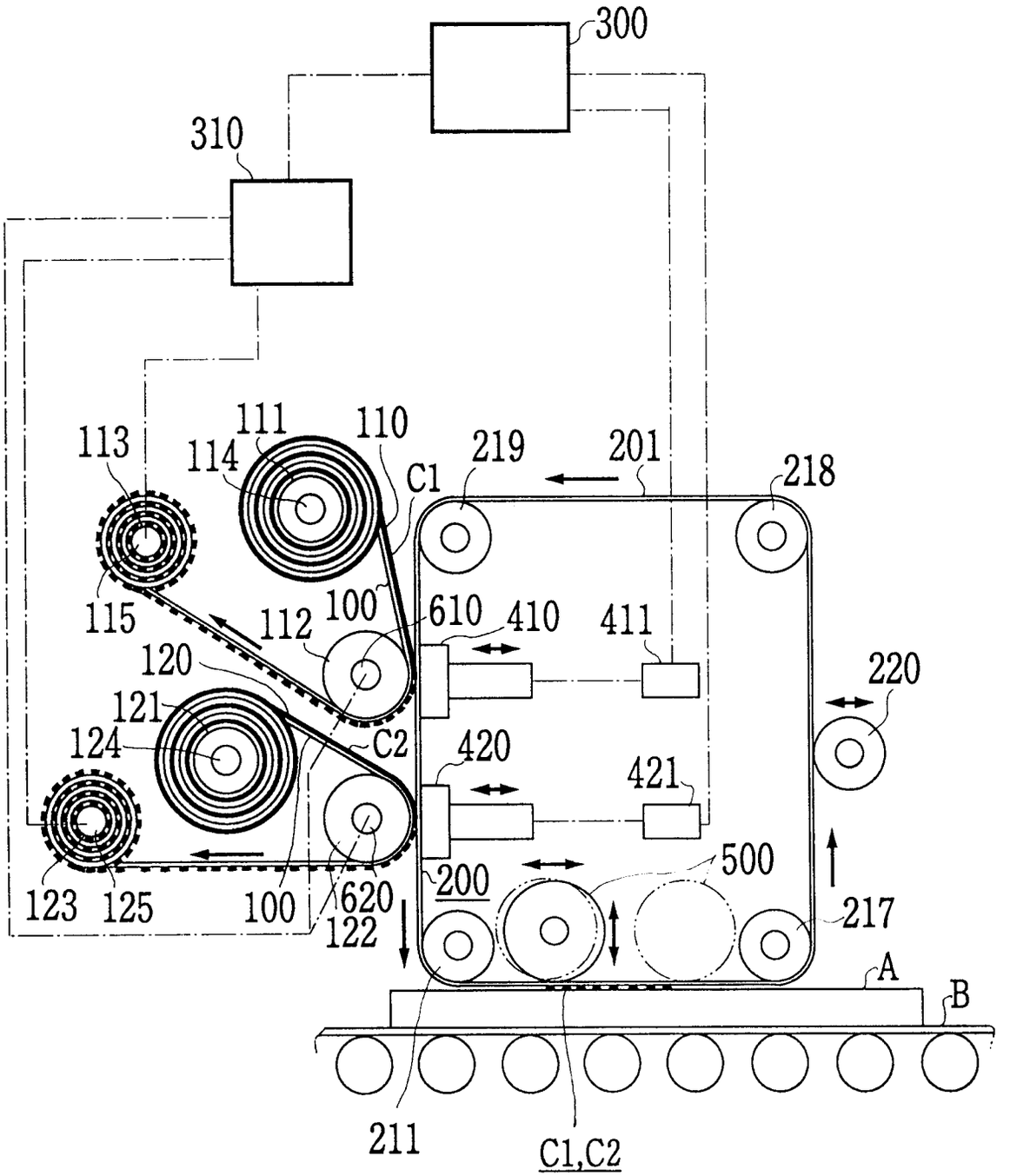
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FIG.9

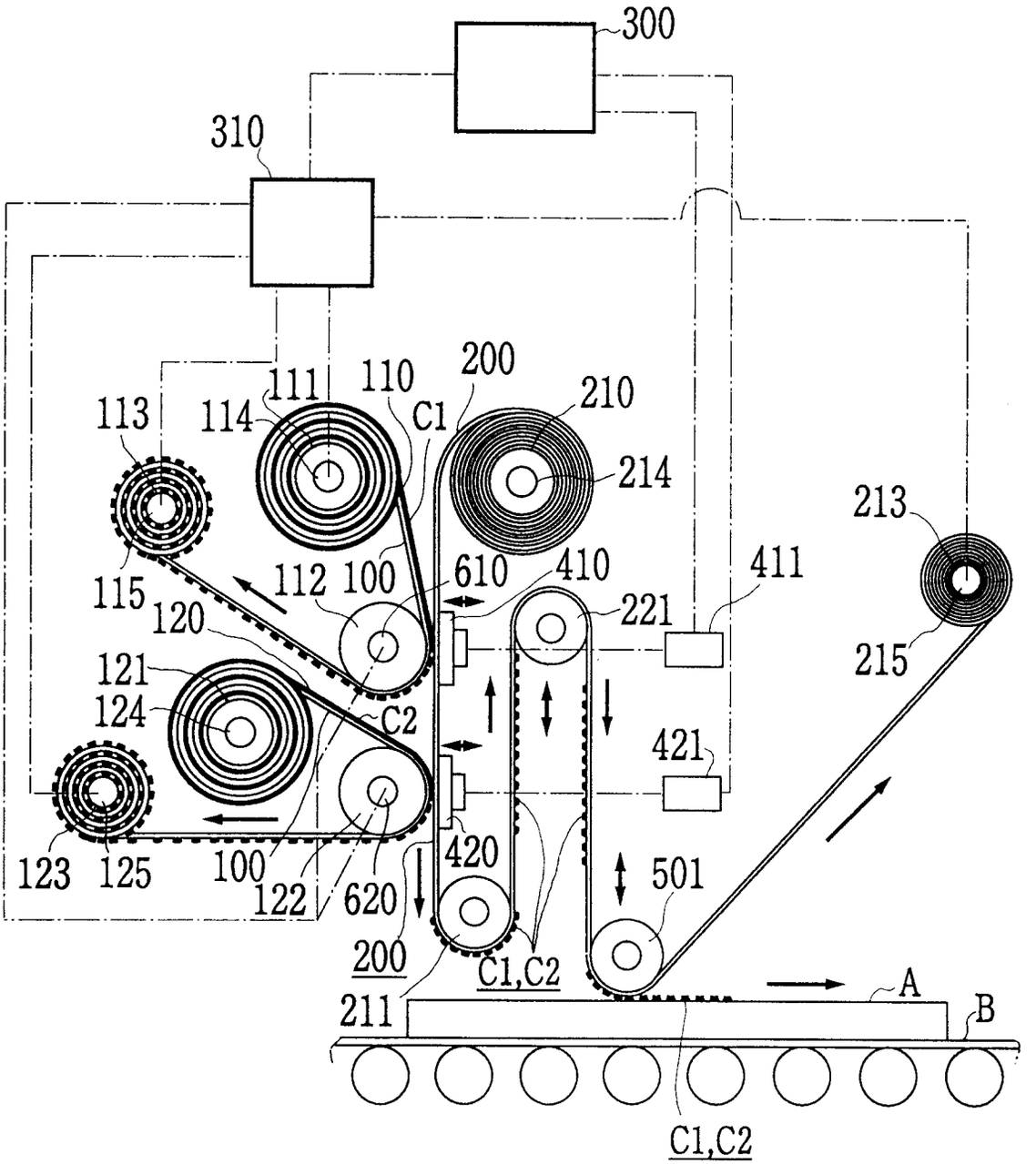
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FIG.10

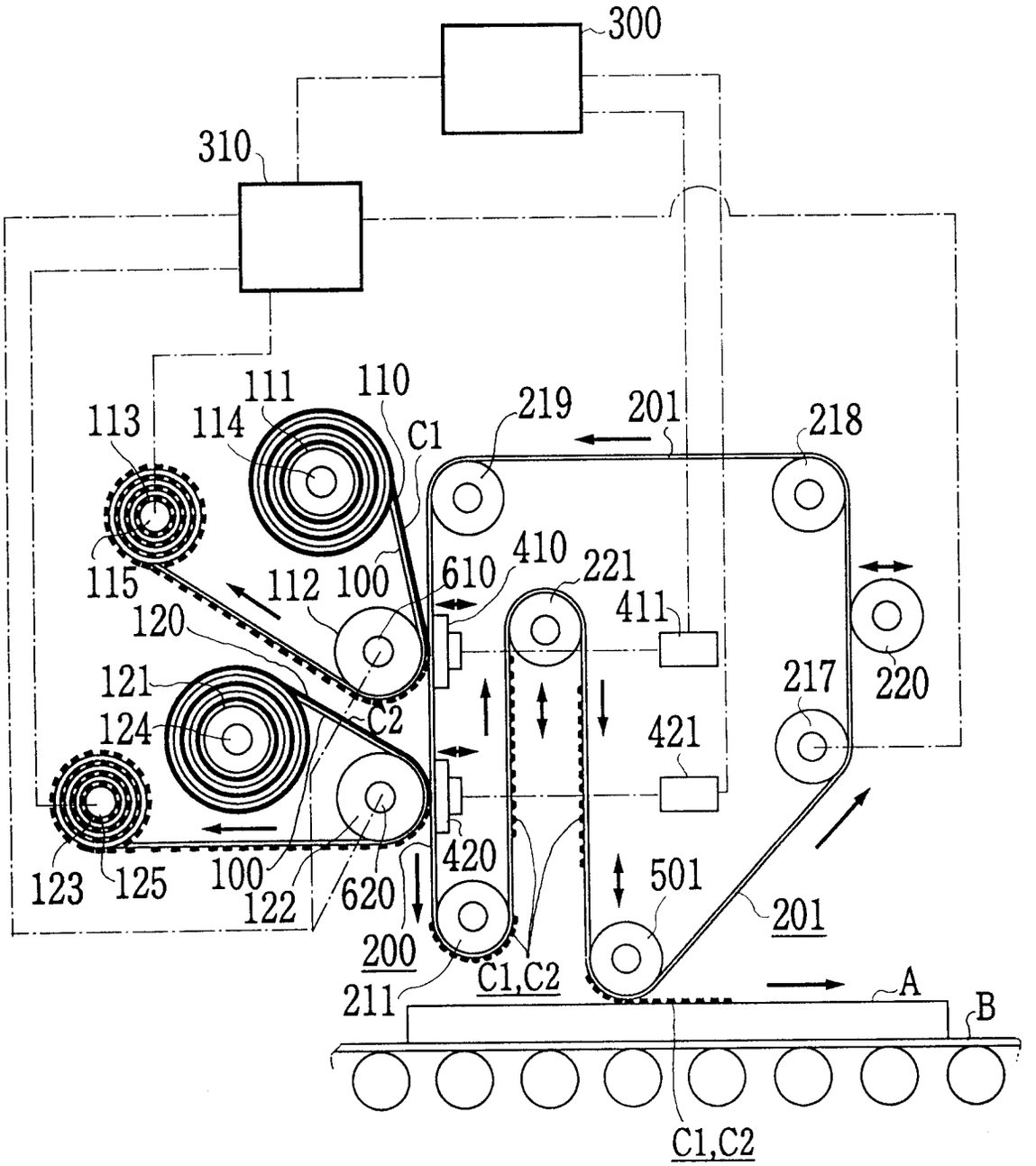
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FIG.11

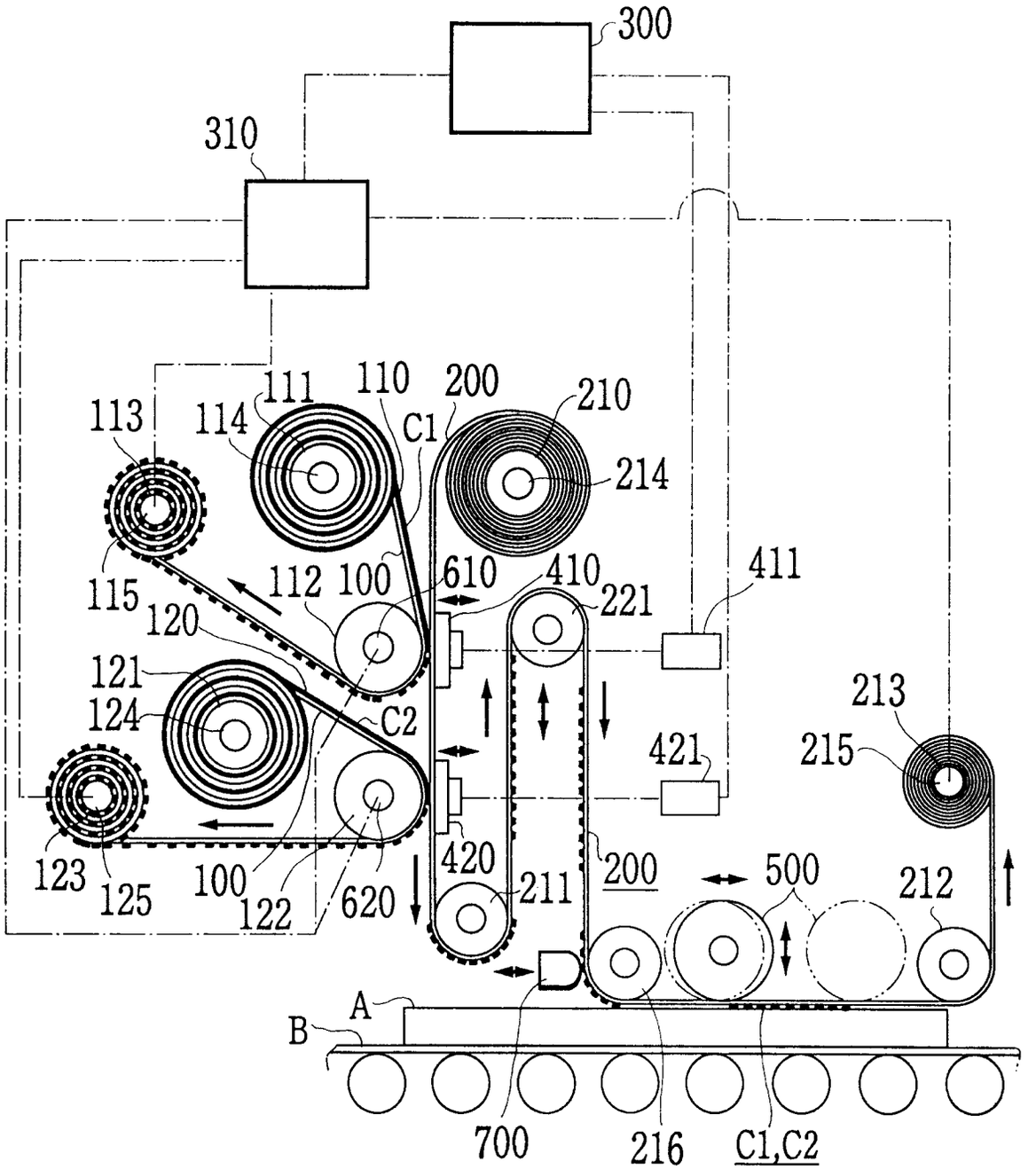
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FIG.12

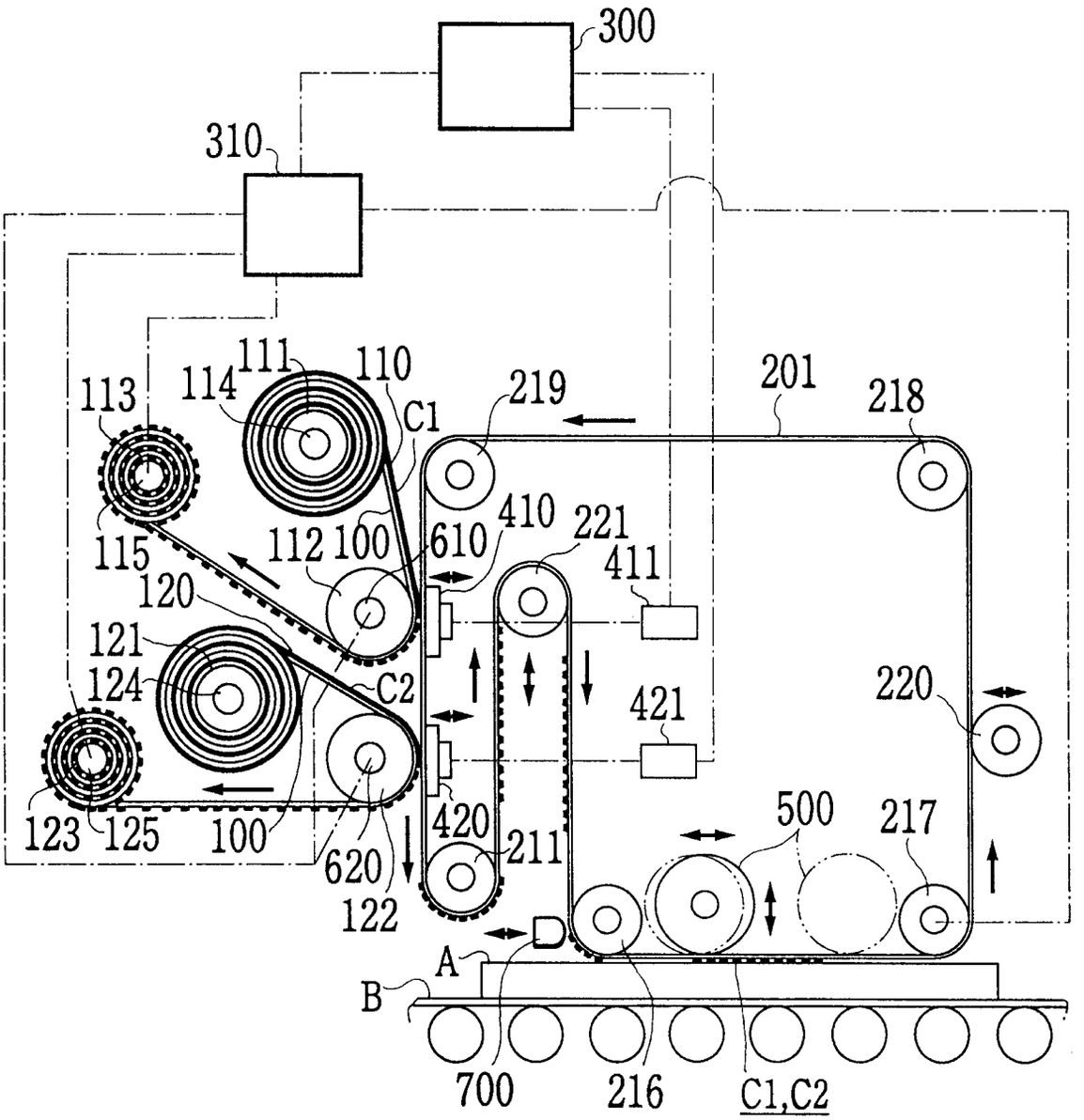
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FIG.13

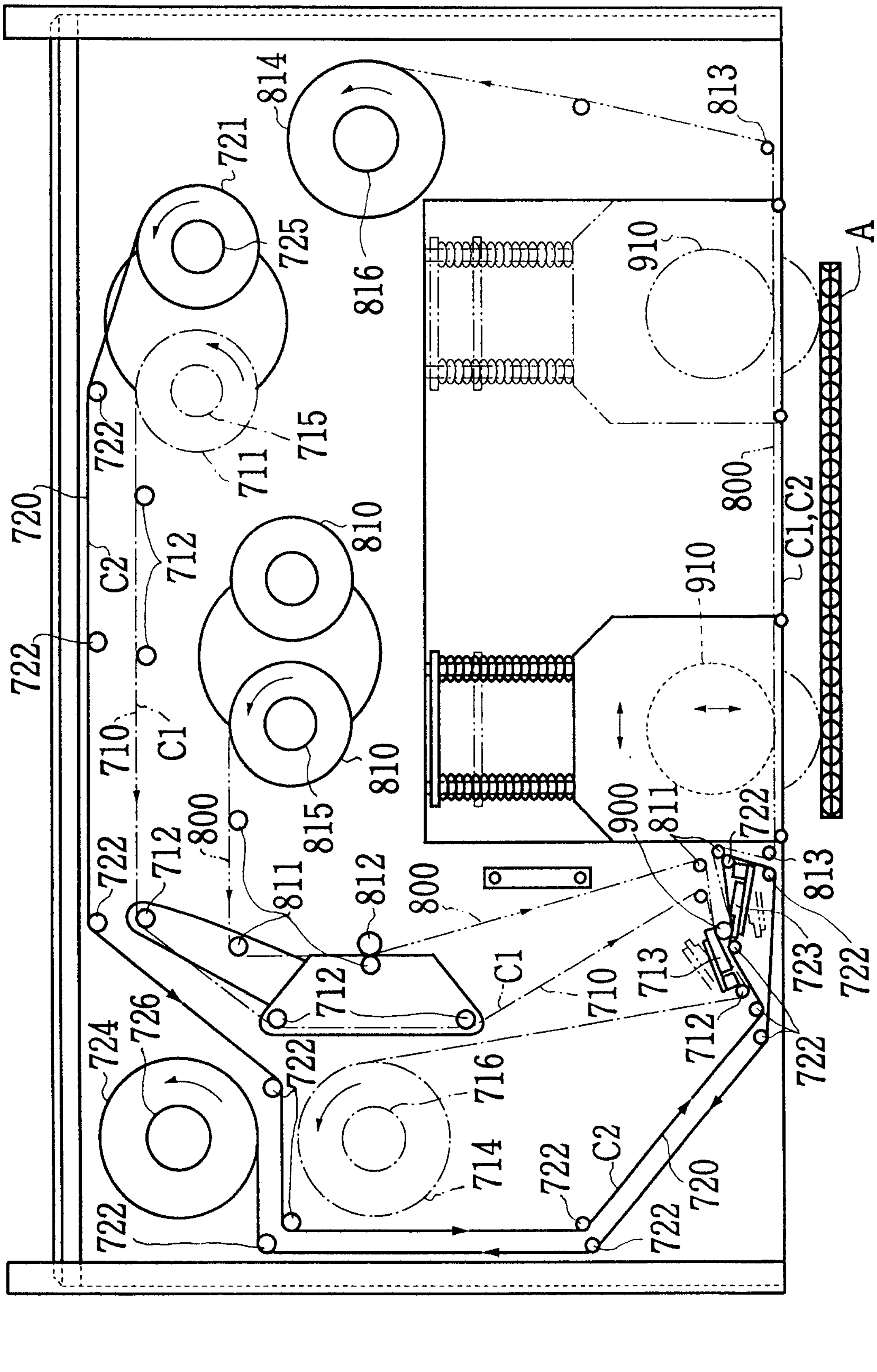

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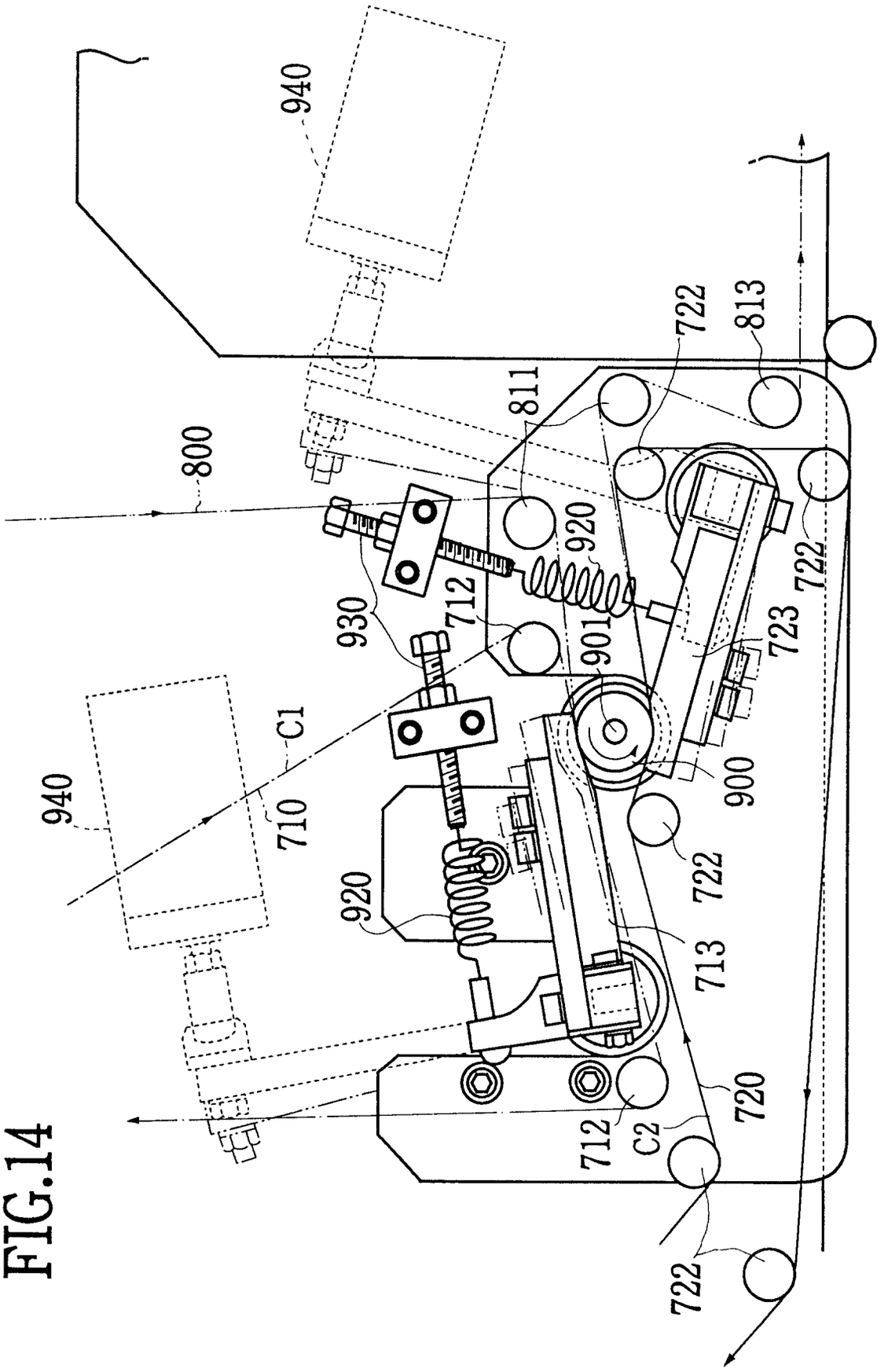
FIG.14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European Patent Office

EUROPEAN SEARCH REPORT

Application Number EP 93115379.5

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y	US - A - 4 504 837 (TOYODA) * Fig. 1,4 *	1,2,7-10,13,14,19-22	B 41 J 2/325
A	--	5,17	
D,Y	EP - A - 0 376 170 (TOHDO) * Totality * & JP-A2-03-227 683	1,7,13	
A	-- US - A - 5 005 028 (TAMURA) * Fig. 3-6 *	1,2,5,7-10,13,14,17,19-22	
A	-- EP - A - 0 262 595 (HITACHI) * Fig. 3 *	1,2,5,13,14,17	
A	-- US - A - 4 893 134 (YAMAMOTO) * Fig. 4 *	1,2,7-9,11-14,19-21,23,24	TECHNICAL FIELDS SEARCHED (Int. Cl.5) B 41 J G 01 D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	14-12-1993	WITTMANN

CATEGORY OF CITED DOCUMENTS

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Y : particularly relevant if combined with another document of the same category
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P : intermediate document

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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

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