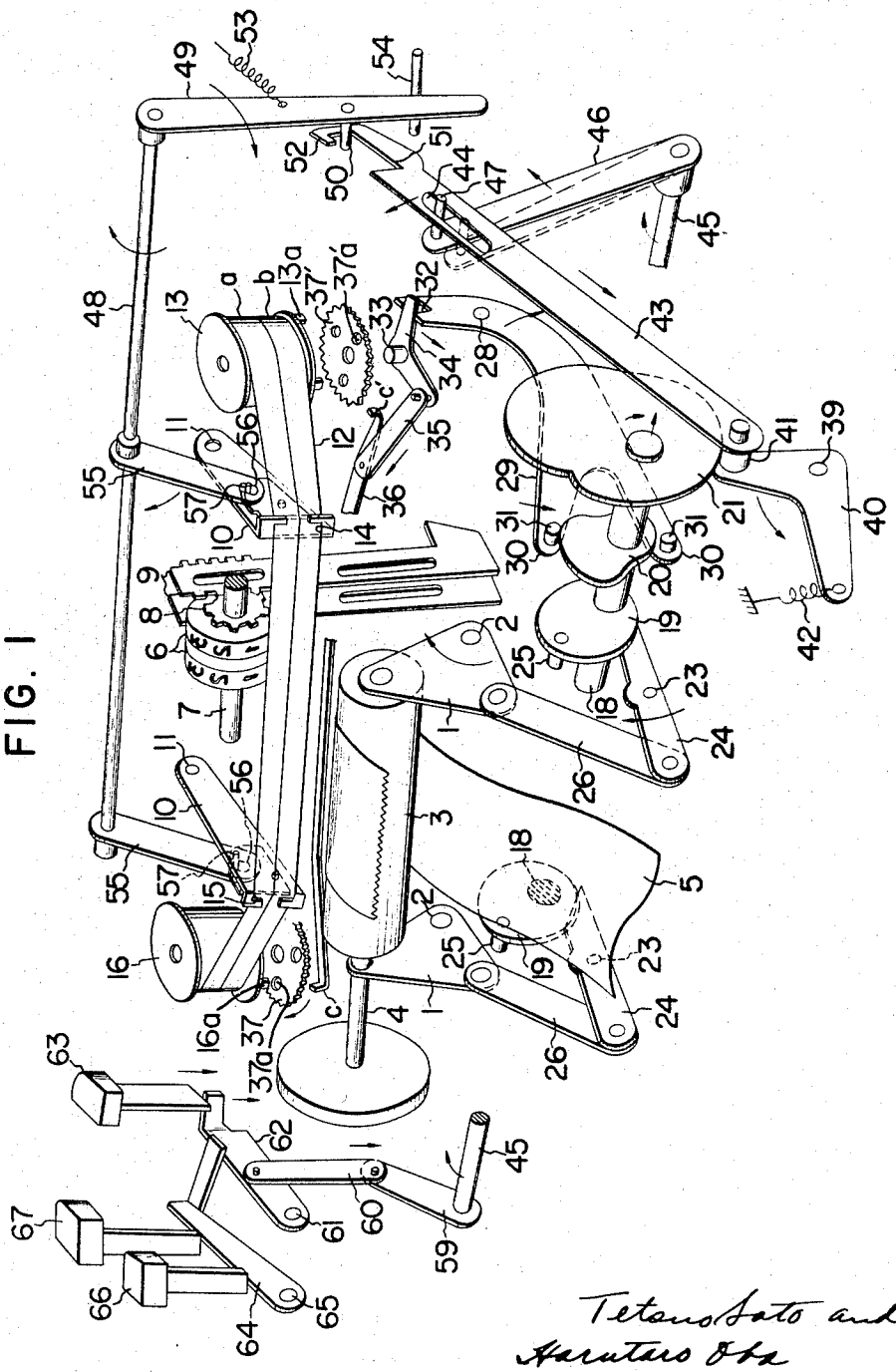
Dec. 10, 1968 TETSUO SATO ET AL 3,415,349

MULTICOLOR PRINTING DEVICE FOR BUSINESS MACHINES AND EQUIPMENT

Filed Dec. 27, 1965 2 Sheets-Sheet 1

FIG. 1



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FIG. 2

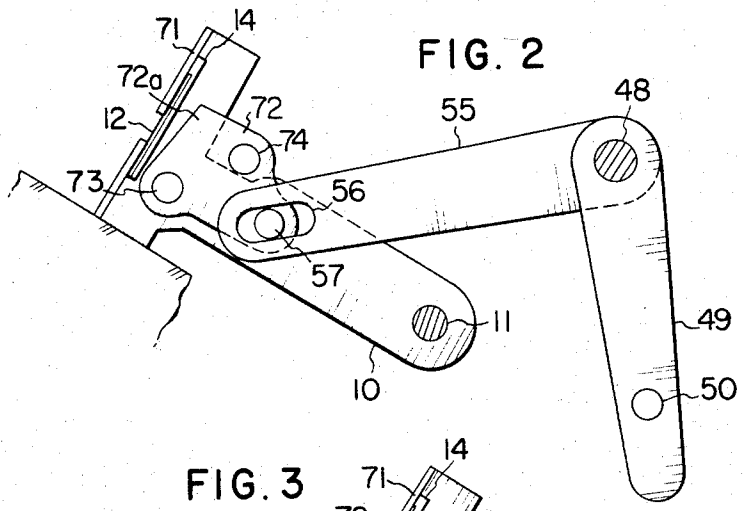


FIG. 3

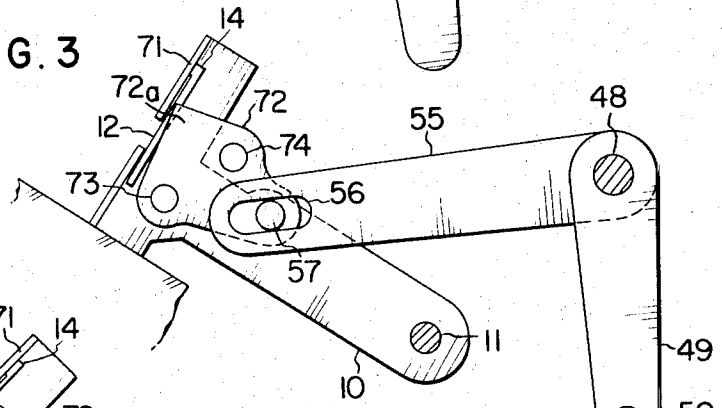
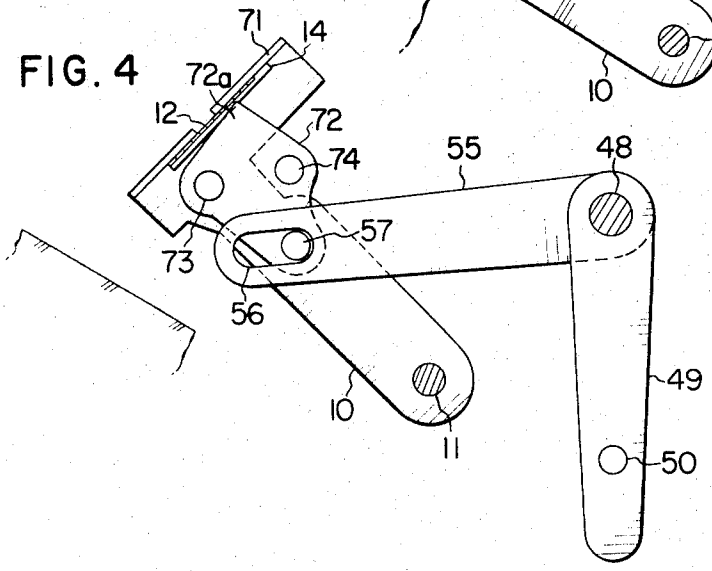


FIG. 4



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MULTICOLOR PRINTING DEVICE FOR BUSINESS MACHINES AND EQUIPMENT

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3 Claims. (Cl. 197—157)

ABSTRACT OF THE DISCLOSURE

A business machine having a cam actuated, key controlled linkage for changing the ribbon field between red and black in accordance with the printing of negative and positive numerals. The ribbon shifting means has two guide levers having respective guide slots therein for guiding the printing ribbon in a straight path between the platen roll and the positioned type faces, and each guide lever has a guide slot at its free end and is pivoted at the other end, whereby said guide slot is shiftable in the transverse, width direction of the ribbon. Two actuating levers are coupled to the ribbon actuating means and are actuated in unison by the actuating movement of each actuating lever first causing respective ribbon holding means to hold the ribbon against movement in its feed direction and then causing the respective guide lever, together with the ribbon so held, to shift, thereby to change the color of printing.

This invention relates to business machines and equipment or office machines and appliances and to writing machines. More particularly, the invention relates to a new and improved printing device for printing numerals or characters in different colors such as red and black in business machines such as electrically-operated adding machines.

In electrically-driven adding machines, in general, numerals to be added and positive total values are printed in black, while numerals to be subtracted and negative total values are printed in red. This printing in the two colors of black and red is generally accomplished by feeding between a platen and type cylinder a ribbon inked with black ink along one lateral side (for example, the upper side) and with red ink along the other side (the lower side), the black ink part of the ribbon being normally placed in the position where the type faces and platen are to contact, thereby to print black numerals, and the ribbon being raised when a red numeral is to be printed, thereby to place the red ink part of the ribbon in the position of contact between the type faces and the platen.

In a conventional printing device of the above described type, the mechanism for raising and lowering the ribbon is actuated by a mechanism which is different from that of the ribbon feeding device and printing device, and furthermore, the mechanism for raising and lowering the ribbon is actuated during the feeding of the ribbon. Accordingly, the ribbon is subject to defective operational states such as twisting and ruffling or bunching.

It is an object of the present invention to overcome the above described difficulty in printing devices of the instant type.

More specifically, an object of the present invention is to provide a printing device for printing numerals and characters in different colors in business machines, in which device the ribbon feeding time and the ribbon shifting time are positively spaced, and, moreover, the ribbon shifting device is prevented from operating while the ribbon is being fed.

Another object of the invention is to provide a printing device of the above stated character wherein the multicolor ribbon is held against movement in the feeding direction while it is being shifted for changing over of colors.

A further object of the invention is to provide a printing device having a relatively simple construction and operation for accomplishing the above stated objects.

Briefly stated, the present invention resides in a printing device for business machines, wherein the ribbon shifting device is actuated by the same cam mechanism used for actuating the ribbon feeding device and, moreover, operates when the ribbon feeding device is at rest.

The nature, principle, and details of the invention will be more clearly apparent from the following detailed description with respect to a preferred embodiment of the invention, when read in conjunction with the accompanying drawing in which like parts are designated by like reference numerals and characters, and in which:

FIG. 1 is a perspective view, partly in exploded form, showing the essential parts and their arrangement of the printing device embodying the invention and related parts; and

FIGS. 2, 3, and 4 are side elevational views showing the sequence of operation of a ribbon shifting device constituting an essential part of the printing device shown in FIG. 1.

Throughout the following disclosure, all directions specifically designated as "left," "right," "front," "rear," "up," and "down," as well as similar designations, refer to those directions as viewed from the left-hand, lower, near side of FIG. 1, the "front" side being the near side or the side nearest the viewer. Accordingly, FIG. 1 is a perspective view of the device as viewed from the right-hand, upper, near side thereof.

Referring to FIG. 1, the business machine (not shown) is provided with a platen device which includes a pair of horizontally separated triangular plates **1**, **1** constituting bell-crank levers pivoted at their lower, rear corners at pivots **2**, **2** and rotatably supporting at their upper corners a horizontal shaft **4** on which a platen roll **3** is rigidly fixed. The platen roll **3** supports, in appropriate position for printing, a length of paper **5** wrapped thereabout.

To the rear of this platen roll **3**, there is provided a set of type wheels **6**, **6**, . . . individually rotatably mounted on a horizontal shaft **7**. A gear **8** is attached to each wheel and mounted on the shaft **7** and is meshed with a corresponding vertical toothed rack **9** which is coupled to a calculating mechanism (not shown).

A ribbon **12** with its upper half *a* inked with black ink and its lower half *b* inked with red ink is horizontally interposed between the type wheels **6**, **6**, . . . and the platen roll **3**, being fed by a ribbon feeding device comprising, in part, ribbon reels **13** and **16** and guide slots **14** and **15** provided, respectively, on the front ends of a pair of guide levers **10**, **10**.

These guide levers **10**, **10** are disposed in a substantially horizontal position on the left and right sides of the type wheels **6**, **6**, . . . and, being pivoted at their rear ends at pivots **11**, **11**, are rotatable thereabout to produce up-and-down movement of the guide slots **14** and **15** whereby the vertical position of the ribbon guided thereby is vertically shifted for changing over between black and red inscription. The guide levers **10**, **10** are actuated by a mechanism described hereinafter with which they constitute a ribbon shifting device.

This ribbon shifting device, the aforementioned ribbon feeding device, and the aforementioned platen roll device are actuated by mechanical motive power transmitted through respective mechanisms described hereinafter from a common driving shaft **18** disposed horizontally below the platen roll **3**. To the driving shaft **18**, there

are fixed imprinting disks **19**, **19** for actuating the platen roll for imprinting action, a feed cam **20** for actuating the ribbon feed device, and a shift cam **21** for actuating the ribbon shifting device.

The imprinting disks **19**, **19** are respectively provided with rigid projecting pins **25**, **25** for engagement with the rear ends of a pair of rocker levers **24**, **24** pivoted at their middle parts on pivots **23**, **23** supported by the machine structure (not shown). The front ends of these levers **24**, **24** are pin-connected through links **26**, **26** to the front corners of the aforementioned triangular plates **1**.

The feed cam **20** is engaged by follower pins **31**, **31** rigidly projecting laterally from the ends of prongs **30** of a fork lever **29** having a curved shape and which is pivoted about a horizontal pivot **28** supported by the machine structure (not shown). The end of the fork lever **29** remote from the prongs **30** is curved upward and is provided at its extremity with a cut-out slot **32** which is engaged with one end of a bell-crank lever **34** pivoted about a vertical pivot **33**. The other end of the bell-crank lever **34** is pin-connected through a link **35** to a point near the right-hand end of a pawl bar **36** having at its left-hand end a pawl tooth *c* engaged with a ratchet wheel **37** fixed to the lower part of the aforementioned ribbon reel **16**. The pawl bar has at its right-hand end a pawl tooth *c'* engaged with a ratchet wheel **37'** which is affixed to the lower part of the ribbon reel **13**. Fixing of the ratchet wheel **37** to the lower part of the reel **16** is attained by engaging the pawls **16***a* provided on the lower periphery of the reel **16** with the apertures **37***a* of the ratchet wheel **37**. Similarly, the ratchet wheel **37'** can be fixed to the reel **13** by engaging the pawls **13***a* provided on the lower periphery of the reel **13** with the apertures **37'***a* of the ratchet wheel **37'**. In the drawing (FIG. 1), the pawl tooth *c*, rachet wheel **37**, and ribbon reel **16**, and the pawl tooth *c'*, ratchet wheel **37'** and ribbon reel **13** are respectively shown spaced apart for the purpose of easy comprehension of their construction, but they are mutually engaged in the assembled state as described hereinabove.

The shift cam **21** is engaged by a follower pin **41** rigidly projecting laterally from one end of a bell-crank lever **40** pivoted on a horizontal pivot **39** supported by the machine structure (not shown). The other end of the bell-crank lever **40** is connected to a spring **42** imparting a force which causes the follower pin **41** to be pressed against the cam **21**.

The outer (right-hand) end of the follower pin **41** is rotatably connected to the front end of a reciprocating bar **43** extending in the front-rear direction and having at an intermediate part along its length an inclined slot **44** which is inclined relative to the centerline of the bar **43**. The inclined slot **44** has engaged therein a pin **47** rigidly fixed to and laterally extending from the upper end of a lever **46** which is fixed at its lower end to a horizontal shaft **45** rotatably supported at the lower part of the machine structure.

The other (rear) end part of the bar **43** is provided with a cutout recess **51**, a lug **52** forwardly projecting over the recess **51** being formed at the extreme end part of the bar **43**. In the recess **51** there is loosely fitted a pin **50** rigidly fixed to and laterally extending from an intermediate part of a lever **49** extending downwardly from and fixed to the right-hand end of a horizontal shaft **48** rotatably supported to extend in the left-right direction above the aforementioned type wheel **6**. The lever **49** is urged rearwardly by a spring **53**, its most rearward position being limited by a stop **54** fixed to the machine structure.

A pair of levers **55**, **55** are fixed in coincident angular positions to the shaft **48**, and slots **56**, **56** formed at the free ends of the levers **55**, **55** are engaged with pins **57**, **57** rigidly fixed to and extending laterally from the sides of the aforementioned guide levers **10**, **10** at points thereof between the slots **15** and **14** and the pivots **11**, **11**. Preferably, the levers **55**, **55** are coupled to the guide levers **10**, **10** in the manner shown in FIGS. 2, 3, and 4 and described hereinafter.

To the other (left-hand) end of the aforementioned shaft **45**, there is fixed a crank lever **59**, whose free end is pin-connected through a link **60** to an intermediate point of a key lever **62** which is pivoted at its front end on pivot **61** supported by the machine structure. The upper edge of the other (rear) end of the key lever **62** is in contact engagement with the lower end of a negative number key **63** adapted to be vertically movable, whereby manual depression thereof causes the key lever **62** to swing downwardly.

Substantially parallel to the key lever **62**, there is provided another key lever **64** which is pivoted at its front end on a pivot **65** supported by the machine structure. The other (rear) end of the key lever **64** has a laterally bent portion thereon which is in contact engagement with the upper edge of the key lever **62** at a point near its rear end. The upper edge of the key lever **64** at intermediate points thereof is in contact engagement with the lower ends of vertically operable keys **66** and **67** for subtotals and grand totals, respectively, the key **67** being farther from the pivot **65** than the key **66**.

The printing device of the above described essential construction and arrangement according to the present invention operates in the following manner.

When the device is in the normal state for printing positive numerals, the lever **46** is inclined toward the near side to the dotted line position opposite to the position shown by full lines in FIG. 1. Accordingly, the reciprocating bar **43** is in its lower position, and the recess **51** is in a position displaced downwardly from the pin **50**.

Then, when the positive number key (not shown) is depressed, the driving shaft **18** is caused to rotate, thereby to rotate the imprinting disks **19**, **19** and cams **20** and **21**. The rotation of the cam **20** thereupon causes the fork lever **29** to rotate in the counter-clockwise direction as viewed from the right-hand side, and the slot **32** moves forwardly to cause the bell-crank lever **34** to rotate clockwise as viewed from above. The rotation of the bell-crank lever **34** is transmitted through the link **35** to move the pawl bar **36** leftwardly, whereby the pawl tooth *c*, acting on the ratchet reel **37**, causes the ribbon wheel **16** to rotate through a certain angle of rotation thereby to wind up the ribbon by feeding it leftwardly a certain length.

Next, the cam **21** causes the bell-crank lever **40** to rotate counterclockwise as viewed from the right, and the reciprocating bar **43** is thereby moved forward, but since the recess **51** is in a position displaced downwardly from the pin **50** as mentioned above, the linkage mechanism consisting of the lever **49**, shaft **48**, levers **55**, **55**, and guide levers **10**, **10** does not operate. Consequently, the black part *a* of the ribbon **12** is positioned in the printing position between the platen roll **3** and the type wheels **6**, **6**, . . .

Accordingly, when the pins **25**, **25** of the imprinting disks **19**, **19** engage and depress the rear ends of the rocker levers **24**, **24**, which thereupon rotate clockwise as viewed from the right and, acting through links **26**, **26**, also cause the triangular plates **1** to rotate clockwise thereby to cause the platen roll **3** to move rearwardly, a black numeral is imprinted on the paper **5** wrapped around the platen roll **3**.

When the negative number key **63** is depressed, or when the total value becomes negative, the key lever **62** is pressed downwardly. This movement of the lever **62** is transmitted through he link **60**, the crank lever **59**, and the shaft **45** to cause the lever **46** to rotate clockwise, whereby the upper edge of the inclined slot **44** is pushed upwardly by the pin **47**. Accordingly, the reciprocating bar **43** is rotated slightly in the upward direction about the pin **41**, whereby the recess **51** is raised to the position of engagement with the pin **50**.

Then, as the driving shaft **18** rotates, the feed cam **20** causes the ribbon **12** to be fed to the left a certain length,

and thereafter the shift cam 21 causes the reciprocating bar 43 to move forward as described above, the rear edge of the recess 51 thereby moving the pin 50 forward. Accordingly, the lever 49 is rotated forwardly, or clockwise as viewed from the right, and this rotation is transmitted through the shaft 48 to cause the levers 55, 55 to rotate upwardly thereby to cause the guide levers 10, 10 also to rotate upwardly. The ribbon 12, being passed through the guide slots 14 and 15 of the guide levers 10, 10, is thereby shifted upwardly by a distance equal substantially to one half of the ribbon width, and the red part *b* thereof is positioned in the imprinting position between the platen rolls 3 and the type wheel 6, 6, . . .

Accordingly, when the pins 25, 25 on the imprinting disks 19 cause the platen roll 3 to move rearwardly, a red numeral is imprinted on the paper 5.

As mentioned hereinbefore, the levers 55, 55 are preferably coupled to their respective guide levers 10, 10 in the manner shown in FIGS. 2, 3, and 4. According to this construction and arrangement, each pin 57 engaging with its respective slot 56 at the end of the lever 55 is rigidly fixed to and laterally projecting from a holding plate 72 pivoted on a horizontal pivot 73 supported by the corresponding guide lever 10 at a point near its guide slot 14 (or 15). The holding plate is provided on its side adjacent to the guide lever 10 with a rigid laterally projecting pin 74 which is engageable with the upper edge of the guide lever 10 and functions as a stop pin. In this case, the extreme front end of the guide lever 10 is bent at right angles just forward of the guide slot 14 (or 15) to form a flange 71.

When the ribbon shifting device is operated as described hereinbefore, and the levers 55, 55 are rotated upwardly, first, each holding plate 72 is caused by the resultant action of its respective slot 56 and pin 57 to rotate about its pivot 73 in the counter-clockwise direction as viewed in FIG. 2, and its upper edge part 72*a* presses against, the flange 71 of the guide lever 10 as indicated in FIG. 3, thereby holding the ribbon 12 interposed therebetween. Simultaneously, the holding plate 72 is prevented from further rotation in the counterclockwise direction about its pivot 73.

Accordingly, the guide lever 10 is then rotated upwardly to the position indicated in FIG. 4 whereby the red part of the ribbon 12 is positioned for printing between the platen roll 3 and type wheel 6, 6, . . . as described hereinbefore. Thus when the levers 55, 55 operate, the holding plates 72 first operate to hold the ribbon 12, and then the guide levers 10, 10 move upward. Therefore, the ribbon 12 is raised in a state wherein it is fixed relative to the guide levers 10, 10. As an advantageous result, the ribbon is fed and shifted without any twisting or ruffling.

As described above, the present invention provides a multicolor printing device wherein, since the ribbon shifting device is driven by power from the same cam mechanism as that of the ribbon feeding device, the ribbon feeding time and the ribbon shifting time can be positively spaced and, moreover, the ribbon shifting device is prevented from operating while the ribbon is being fed. Therefore, defective operation wherein the ribbon is twisted or ruffled is prevented. Furthermore, the action of the holding plates 72 in holding the ribbon while it is being shifted and used in printing further assures prevention of twisting and ruffling.

It will be obvious that the timing of the ribbon feeding and the ribbon shifting operations can be suitably adjusted by changing the relative angular positions of the feed cam 20 and the shift cam 21 on the driving shaft 18. Furthermore, while in the above described example, printing is accomplished by actuating the platen roll, equivalent printing can be accomplished also by actuating the type wheel or actuating both the platen roll and the type wheel. Another possible modification is to use, instead of a type wheel, a vertically movable type bar provided with type faces alined vertically thereon.

What we claim is:

1. In a business machine, a multiple-color printing device comprising, in combination: a platen device including a platen roll for feeding and supporting a writing sheet in position on the platen roll for printing thereon; imprinting means having type faces which can be positioned to confront the writing sheet on the platen roll for imprinting thereon over a printing ribbon interposed therebetween and having a mechanism intercoupled to the operation of the business machine for positioning the type faces in response to said operation, said ribbon being a multi-color type with longitudinal inked bands of different colors; ribbon feeding means for feeding the ribbon between positioned type faces and the writing sheet on the platen roll; ribbon shifting means for shifting the ribbon in a transverse direction relative to the positioned type faces thereby to change the color of printing; printing means for causing relative imprinting movement of the positioning type faces and the platen roll; and ribbon actuating means coupled to the ribbon feeding means and the ribbon shifting means for actuating the ribbon feeding means and the ribbon shifting means in interlocked operation at spaced intervals in time, said ribbon shifting means comprising two guide levers having respective guide slots therein for guiding the printing ribbon in a straight path between the platen roll and the positioned type faces, each guide lever having its respective guide slot at its free end and being pivoted at the other end whereby said guide slot is shiftable in the transverse, width direction of the ribbon, two actuating levers coupled to the ribbon actuating means and actuated in unison by the ribbon actuating means, and a ribbon holding means supported on each guide lever and coupled to the free end of one of the actuating levers, actuating movement of each actuating lever first causing the respective ribbon holding means to hold the ribbon against movement in its feed direction and then causing the respective guide lever, together with the ribbon so held, to shift, thereby to change the color of printing.

2. The multiple-color printing device according to claim 1, wherein the ribbon actuating means comprises cams and mechanisms driven by said cams respectively for actuating the ribbon feeding means and the ribbon shifting means, said cams being driven by a common driving shaft.

3. The multiple-color printing device according to claim 1, wherein the ribbon actuating means and the printing action means are driven by a common driving member.

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