United States Patent [19]

Tamai

[11] **3,920,113**

[45] **Nov. 18, 1975**

[54] **PLATEN ROLL ARRANGEMENT FOR TYPEWHEEL PRINTER**

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[73] Assignees: **Kabushiki Kaisha Suwa Seikosha,** Tokyo; **Shinshu Seiki Kabushiki Kaisha,** both of Japan

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[21] Appl. No.: **409,825**

[30] **Foreign Application Priority Data**

Oct. 26, 1972 Japan 47-107335

[52] **U.S. Cl.** **197/51;** 101/93.48; 101/270; 101/376; 197/144

[51] **Int. Cl.²** **B41J 1/32**

[58] **Field of Search** 197/48, 51, 18, 144, 145, 197/146, 147, 49; 101/376, 93.48, 270, 271

[56] **References Cited**

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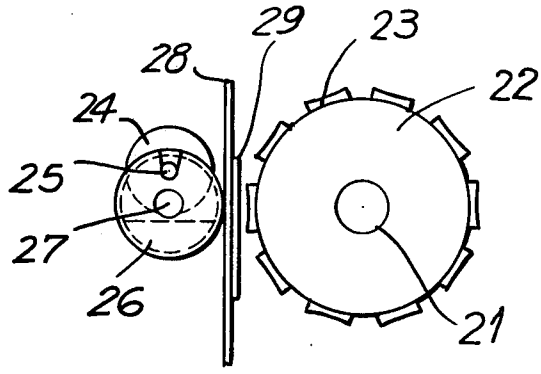
Primary Examiner—Clifford D. Crowder

Attorney, Agent, or Firm—Blum Moscovitz Friedman & Kaplan

[57] **ABSTRACT**

A compact printer of the type having at least one print wheel, a carried paper web for receiving an imprint, and, for instance, an ink ribbon for imprinting a character of the print wheel on the paper web includes a print roller for impressing the ink ribbon and paper web selectively into the print wheel. The print roller comprises a press roller for pressing and rolling characters or the like circumferentially arranged on the print wheel, at a print position thereof, through the ink ribbon and paper web for forming an imprint thereon, a rotatable holder for the press roller which is rotatable on its own axis and has a recess therein for seating the press roller. The press roller includes a shaft which is journaled into the holder. The press roller has a radius which is longer than the difference between the journal radius of the holder and the distance between the axis of the holder and the corresponding axis of press roller.

6 Claims, 12 Drawing Figures



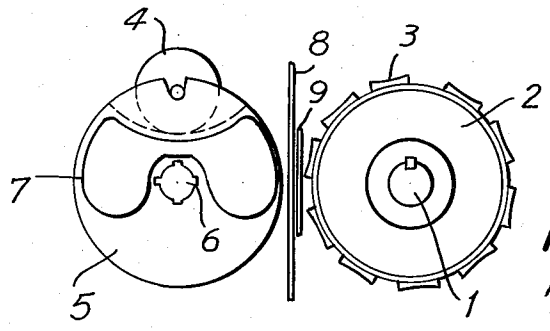


FIG. 1a
PRIOR ART

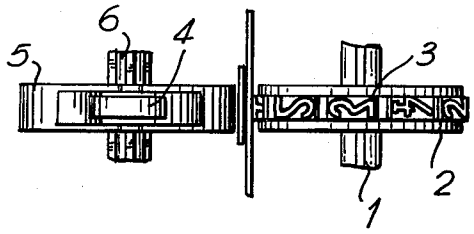


FIG. 1b
PRIOR ART

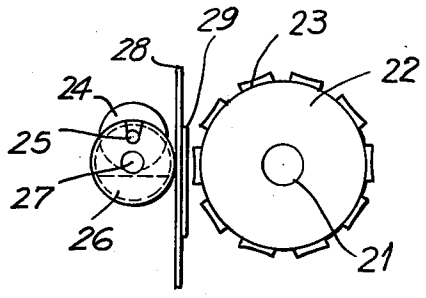


FIG. 2a

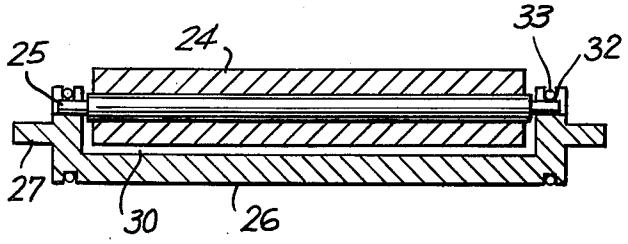


FIG. 2b

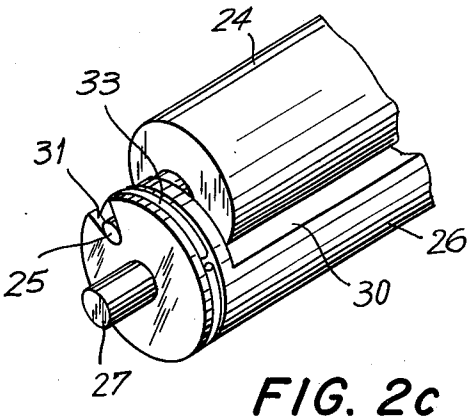


FIG. 2c

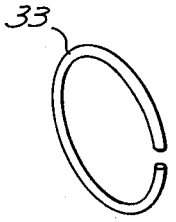


FIG. 2d

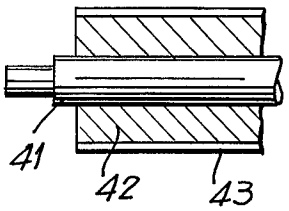


FIG. 3a

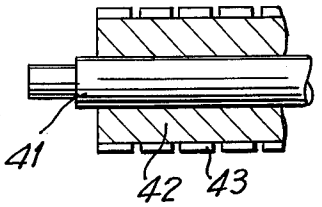


FIG. 3b

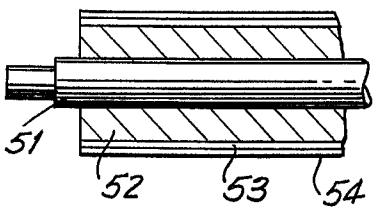


FIG. 4

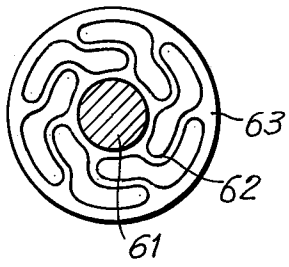


FIG. 5

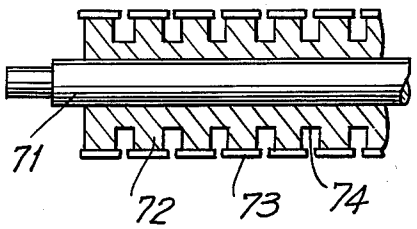


FIG. 6

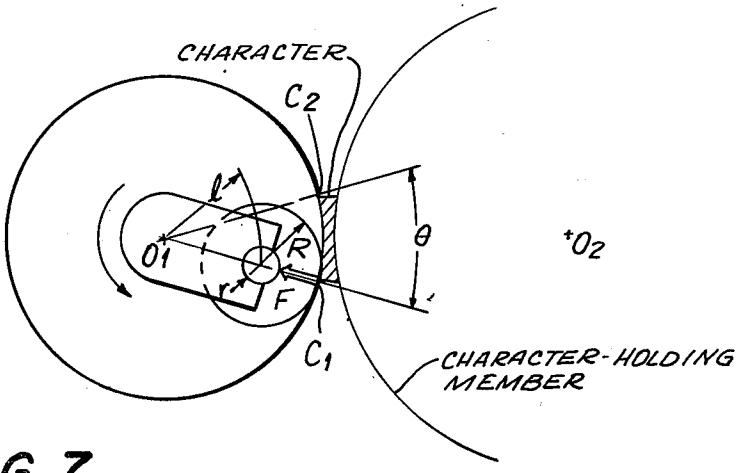


FIG. 7

PLATEN ROLL ARRANGEMENT FOR TYPEWHEEL PRINTER

BACKGROUND OF THE INVENTION

This invention relates to a printing assembly for a printer and more particularly for a compact printer.

Ultra compact electronic table calculators are now available which employ an LSI in the electronic circuit thereof and employ an LED and liquid crystals in the display thereof. Thus, according to today's standards, highly compact, lightweight equipment which utilizes a minimum of power is in substantial demand.

In the past, it has not been possible to develop table calculators that include a printer assembly according to today's standards of compactness, weight and power consumption. Substantial demand has therefore been generated for a table calculator having a printer assembly which meets today's standards of compactness, weight and power consumption.

Accordingly, it is an object of this invention to provide a printer assembly for a compact printer wherein the load torque at printing is reduced, thereby concomitantly reducing power consumption of the printer assembly as employed with a table calculator.

It is a further object of the present invention to provide a printer assembly for a table calculator which employs a minimum number of moving parts, which is easily assembled or disassembled and performs highly satisfactorily.

SUMMARY OF THE INVENTION

Generally speaking, in accordance with the invention, an improved printer assembly for a compact calculator is provided for selectively printing a character, number, symbol or the like in clear fashion on an imprint receiver, for instance, paper, including character carrying means for carrying print characters or the like on the surface thereof, a press roller for pressing and rolling characters or the like circumferentially arranged on the character carrying means at a print position thereof through an imprint receiving means, for instance, paper, and a rotatable holder for the press roller rotatable on its own axis and having a recess therein for seating the press roller.

In practice, the number of characters circumferentially arranged on a given character carrying means will determine the number of aligned character carrying means employed in the printer for printing the selected array of characters. Hereinafter in the specification and claims, a description of one member of the printer assembly will therefore serve as a description for all members of the composite.

The character carrying means is rotatably mounted on a shaft for locating a selected character in a print position until the selected character is axially aligned with the press roller, hereinafter described in greater detail. Interpositioned between the character carrying means and press roller are imprint receiving means and print means, for instance, an ink ribbon. Proximate the character carrying means is located the ink ribbon and proximate the press roller is located the imprint receiver, for instance, paper.

The press roller is carried in a holder having a camming groove for selectively unseating the press roller radially for pressing the press roller against the imprint receiver, print means, and selected character at a selected time sequence for thereby pressing an imprint on the imprint receiver through the print means.

Still other objects and advantages of the invention will in part be obvious and will in part be apparent from the specification.

The invention accordingly comprises the features of construction, combinations of elements, and arrangement of parts which will be exemplified in the constructions hereinafter set forth, and the scope of the invention will be indicated in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

For a fuller understanding of the invention, reference is had to the following description taken in connection with the accompanying drawings, in which:

FIG. 1*a* is a side elevational view in schematic form of a conventional printer assembly for a compact calculator;

FIG. 1*b* is a top plan view of the conventional printer assembly shown in FIG. 1*a;*

FIG. 2*a* is a side elevational view in schematic form of a printer assembly for a compact calculator constructed in accordance with this invention;

FIG. 2*b* is a detail view of the press roller holder;

FIG. 2*c* is an exploded perspective view of a segment of the press roller and press roller holder;

FIG. 2*d* is an exploded perspective view of the retaining ring for securing the press roller movably in the press roller holder;

FIGS. 3*a* and 3*b* are detail views of other embodiments of press rollers and press roller holders constructed according to this invention;

FIG. 4 is a detail view of yet another type press roller and holder therefor;

FIG. 5 is a sectional view of another press roller embodiment constructed in accordance with the invention;

FIG. 6 is a sectional view of yet another press roller embodiment constructed in accordance with the invention; and

FIG. 7 is a schematic view showing the relationship of parts of the various embodiments.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIGS. 1*a* and 1*b* which are illustrative of conventional printers, a pattern carrier 2 is rotatably mounted on a shaft 1 and characters 3 are circumferentially located on the periphery of pattern carrier 2. Usually, there are a number of aligned pattern carriers equal in number to the number of characters 3 circumferentially arranged on a given pattern carrier 2. By means not shown, pattern carrier 2 is rotated on shaft 1 for arranging a selected character 3 at a print position. in the print position, the selected character is substantially parallel with imprint means 9, for instance, an ink ribbon, and imprint receiver 8, for instance, a paper web. A pressure disc 5 is rotatably mounted on a shaft 6 and supports a platen roll 4 for impressing an imprint of the character on paper web 8 through ink ribbon 9. As pressure disc 5 is rotated on shaft 6, platen roll 4 is rolled and pressed against character 3 through paper web 8 and ink ribbon 9 for thereby completing a print. During the printing operation, elastically deformable member 7 of pressure disc 5 is elastically deformed, by means not shown for pressing against platen roll 4.

In this conventional type printer, substantial distance between the center of pressure disc shaft **6** and the center of platen roll **4** must be maintained. As a result thereof, a substantial printing load torque must be applied because the load torque increases proportionally to the distance between respective axes of disc **5** and platen roll **4.** As the load torque increases, the motor and power transmitting portion necessarily increase in size for generating the required power. Under these circumstances of construction, it is difficult to compact the printer portion for use in a table calculator, to lighten the printer portion and lower the power consumption thereof.

Moreover, in conventional printers of the type shown, elastic deformable portion **7** has a larger spring constant as platen roll **4** is deformed toward the axis of disc **5** than when platen roll **4** is deformed in the direction of the circumference of pressure disc **5.** Consequently, as platen roll **4** is applied on a selected character **3** at a print time, member **7** undergoes substantial deformation toward the circumferential edge of disc **5.**

In the printing operation, platen roll **4** is rolled over the selected character **3** on its own axis under the rotating influence of disc **5** rotated on shaft **6.** Under the spring force of deformed member **7,** platen roll **4** is moved over the print character for an imprint faster than the angular velocity of pressure disc **5.** Accordingly, characters imprinted on paper web **8** may be difficult to read because the printing sequence results in dark and light print portions.

In these conventional printers, the radial length of pressure disc **5** is longer than the axial width of the mounting portion for the disc, and as a result thereof, pressure disc **5** inclines axially whereby there is an uneven dark and light imprint on respective sides of the selected printed character. Since the printer comprises aligned series of pattern carriers and pressure discs, this uneven printing is perpetuated through each printed column. Therefore, these conventional printers print unevenly, are bulky, difficult to maintain, and costly to operate.

The disadvantages of the prior conventional printers are overcome by the instant invention. Referring now to FIGS. **2***a-d*, an improved print means has been found which replaces the conventional pressure disc and platen roll construction heretofore used. Pattern carrier **22** is of the conventional type and is rotatably mounted on shaft **21.** Circumferentially arranged on the periphery of pattern carrier **22** are characters **23.** A number of pattern carriers may be axially arranged to coincide in number with the number of circumferentially arranged characters **23.** A selected character **23** to be printed is rotated to a position oppositely rotatable holder **26.** Holder **26** is mounted on a shaft **27** and rotates thereon. Seated in holder **26** is press roller **24** for pressing and rolling paper web **28** and ink ribbon **29** into and over the selected character **23** for securing an imprint thereof on paper web **28.** Press roller **24** is fabricated of a suitable elastic material, for instance, rubber or plastic, and is rotatably mounted on a shaft **25** which is freely seated in recesses **31** of holder **26.** As best seen in FIG. **2***b*, press roller **24** is freely rotatable in recess **30** of holder **26.**

Press roller **24** is supported on shaft **25** in such way that the radius of press roller **24** is longer than the difference between the journal radius of holder **26** and the distance between the rotational center of holder **26** and the axis of press roller **24.** The journal radius of holder **26** is the radius of shaft **27.** Accordingly, load torque at printing time is commensurately reduced and the printer is more compact and lighter in weight than those of the conventional type.

When holder **26** is rotated from a rest position around journal **27,** press roller **24** is simultaneously rotated around journal **27.** As press roller **24** is pressed and rolled over a selected character **23,** arranged in a printing position on pattern carrier **22,** an imprint thereof is received on paper web **28** through ink ribbon **29.** After the printing operation is completed, press roller **24** and holder **26** are brought to a rest position and the printing cycle is complete.

Referring particularly to FIGS. **2***b*, **2***c* and **2***d*, holder **26** is provided with peripheral recesses for seating therein and supporting press roller shaft **25.** To prevent press roller shaft **25** from slipping out of recesses **31,** annular retaining ring **33** fabricated of resilient material is elastically seated in each circumferential groove **32** provided in the periphery of holder **26.**

It is thereby possible to provide an inexpensive printer which performs reliably. It is easy to assemble and disassemble and includes few moving parts.

Referring now to FIG. **7,** which is not drawn to scale, it will be seen that load torque at printing time for the instant embodiment is reduced as compared with the required load torque for a conventional printer. In FIG. **7,** $\mathbf{0}_1$ designates the rotational axis of holder **26;** $\mathbf{0}_2$ designates the rotational axis of pattern carrier **22;** l is the distance between the rotational axis of holder **26** and the rotational axis of press roller **24;** R is the radius of press roller **24;** r is the journal radius of press roller shaft **25;** θ is the angle between $\mathbf{0}_1$ and edges of selected character **23;** F designates printing pressure; T designates the torque about the point $\mathbf{0}_1$ and μ is the coefficient of friction between the journal of the press roller shaft and the bearing of the holder. The expression for energy required to roll press roller **24** from point C_1 to point C_2 over the surface of selected character **23** may be derived as follows:

$$T\theta = \mu Fr\ (2 + l/R\ )\ \theta + Eh$$

Eh represents deforming energy for the press roller as it rolls over the surface of the selected character. Loss in rotary shaft R_1 of the holder is omitted as insignificant. The above equation may be balanced to express torque as follows:

$$T = \mu Fr\ (2 + l/R) + Eh/\theta$$

As expressed in the equation, μ, F, and r are fixed when the desired printing quality is obtained. Also fixed is Eh/θ, which represents the deforming energy of the press roller to the unit angle of rotation. When the size of the print means, holder and press roller are fixed, then $R + l$ is fixed and the torque T about point O_1 is commensurately small; but it is sufficiently satisfactory if l is small and R is comparatively large. Therefore, according to the invention, it is possible to adjust l to make it sufficiently small or to adjust R and make it comparatively large relative thereto and thereby reduce load torque. In the conventional printer, as R is increased l is also increased.

According to the instant invention, the size and weight of the printer may be reduced, because l is reduced for reducing $l + R$ for reducing load torque. Since the printer operates under a reduced load torque at printing time, the motor and power transmitting system therefor may also be compacted for lightness and

lower power consumption. Since the improved printer does not employ a pressure disc of the type used in conventional printers, the rolling speed of the press roller may be fixed during printing and since the press roller is not inclined, an even print is obtained.

The press roller may be modified in various ways for use in connection with the holder. Referring now to FIGS. 3*a* and 3*b*, tubular pressing member **43**, suitably fabricated of rubber, plastic, metal and the like, surrounds elastic member **42**, suitably fabricated of rubber, plastic and the like. Axially mounted in elastic member **42** is press roller shaft **41**. Preferably, pressing member **43** is more resilient than elastic member **42**.

As the press roller rolls over a selected character for imprinting the character on a paper web, elastic member **42** deforms but pressing member **43** only slightly deforms, whereby pressing member **43** contacts the character surface substantially linearly and a satisfactory imprint is obtained. As shown in FIGS. 3*a* and 3*b*, pressing member **43** may be continuous or ridged.

Referring now to FIG. **4** which illustrates a preferred press roller, the tubular pressing member **53** is sandwiched between a tubular elastic member **54** and an elastic member **52** which is rotatably mounted on shaft **51**. Elastic members **52** and **54**, as well as pressing member **53** may be fabricated of rubber, plastic and the like. Preferably, pressing member **53** is harder than elastic members **52** and **54**. During printing, elastic member **54** rolls over the character contour for a highly satisfactory imprint.

Referring now to FIG. **5** which illustrates another press roller preferred embodiment, the character pressing portion **63** surrounds a discretely slotted elastic deformable portion rotatably mounted on press roller shaft **61**. Referring now to FIG. **6** which illustrates yet another preferred press roller embodiment, pressing member **73**, suitably fabricated of rubber or plastic overlies elastic member **72**, also suitably fabricated of rubber or plastic, which is rotatably mounted on shaft **71**. Pressing member **73** is preferably harder than elastic member **72**. Elastic member **72** is provided with ridges **74** in the periphery thereof corresponding to the distance between each discrete pressing member **73**. During the printing operation, only certain of the elastic members **72** undergo deformation while other of the members **72** do not due to ridges **74** and an even imprint is obtained.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently attained and, since certain changes may be made in the above constructions without departing from the spirit and scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

What is claimed is:

1. In a compact printer of the type including at least one rotatable pattern carrier having a circumferential array of characters, numbers, symbols and the like arranged on the peripheral surface thereof, an imprint means for transmitting an imprint of a selected character of said pattern carrier on an imprint receiver, and an imprint receiver, a print means comprising a press roller for pressing and rolling characters or the like circumferentially arranged on said pattern carrier at a print position thereof against said imprint receiver, a rotatable holder for said press roller rotatable on its own axis and having a recess therein for seating said press roller, a shaft for said press roller, a pair of opposed recesses in the periphery of said holder in which opposed ends of said shaft are journaled, said press roller being freely accommodated in said recess therefor provided in said holder, said press roller having a radius which is longer than the difference between the journal radius of said holder and the distance between the axis of said holder and the axis of said press roller.

2. The print means of claim **1** including a pair of annular rings for retaining opposed ends of said press roller shaft in said opposed recesses of said holder, and a pair of circumferentially arranged grooves in the periphery of said holder for seating said annular rings.

3. The print means of claim **2** wherein said press roller comprises an elastic member, a rotary shaft axially mounted through said elastic member and a tubular pressing member overlying said elastic member.

4. The print means of claim **3** including a tubular elastic member overlying said pressing member.

5. The print means of claim **3** wherein said pressing member is characterized as harder than said elastic member.

6. The print means of claim **2** wherein said press roller comprises a circumferentially ridged elastic cylindrical member, a rotary shaft axially mounted through said ridged elastic member and discrete annular pressing members overlying annular ridges of said elastic member.

* * * * *