United States Patent

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[54] **RECIPROCABLE PLATEN IN SELECTIVE PRINT WHEEL PRINTING MACHINE**
4 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **101/96,** 101/92, 101/274
[51] **Int. Cl.** **B41j 35/00;** B41l 47/46
[50] **Field of Search** 197/168, 171; 101/91, 92, 93Max, 96, 94, 95, 93Min, 96RC, 269, 274

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ABSTRACT: A printing mechanism suitable for use in combination with a business machine, or the like, utilizes a pivotally reciprocating print roller for printing. The print roller is rotatable about an axis parallel to a first shaft on which is rotatably mounted a set of print wheels having print facets thereon. The roller is pivotally mounted on a second shaft which is also positioned parallel to and spaced apart from the first shaft at a distance sufficient for the print roller to exert a rolling pressure on a record material disposed between the print wheels and the reciprocating print roller. A cyclically rotating cam drive is used for pivotally reciprocating the print roller during each printing operation to move it from a first position above those print facets which are in a printing position, to a second position which is defined by a plane that includes the axis of the print roller and the axis of rotation of the first shaft and intercepts the lower surface of the print facets in the printing position, and to return it to the first position.

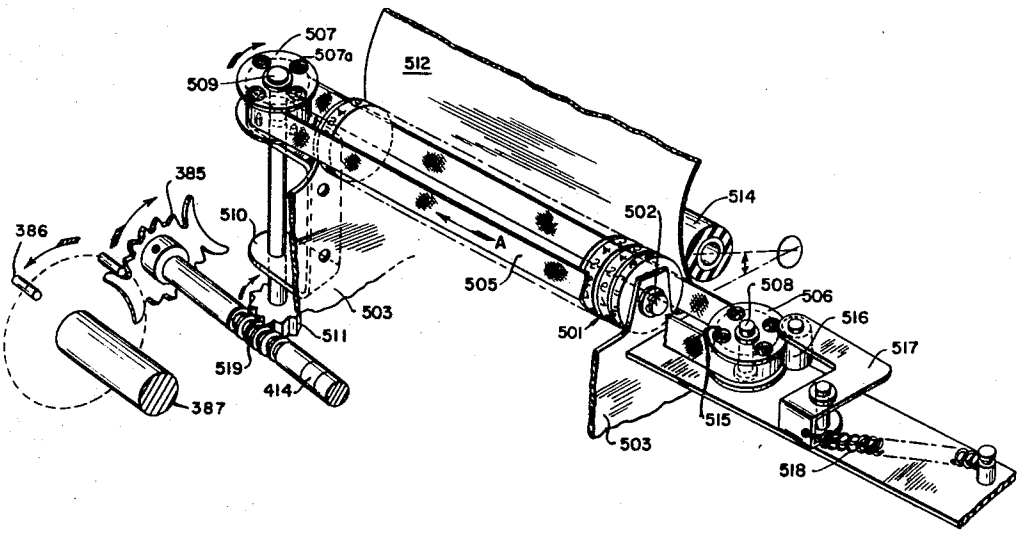
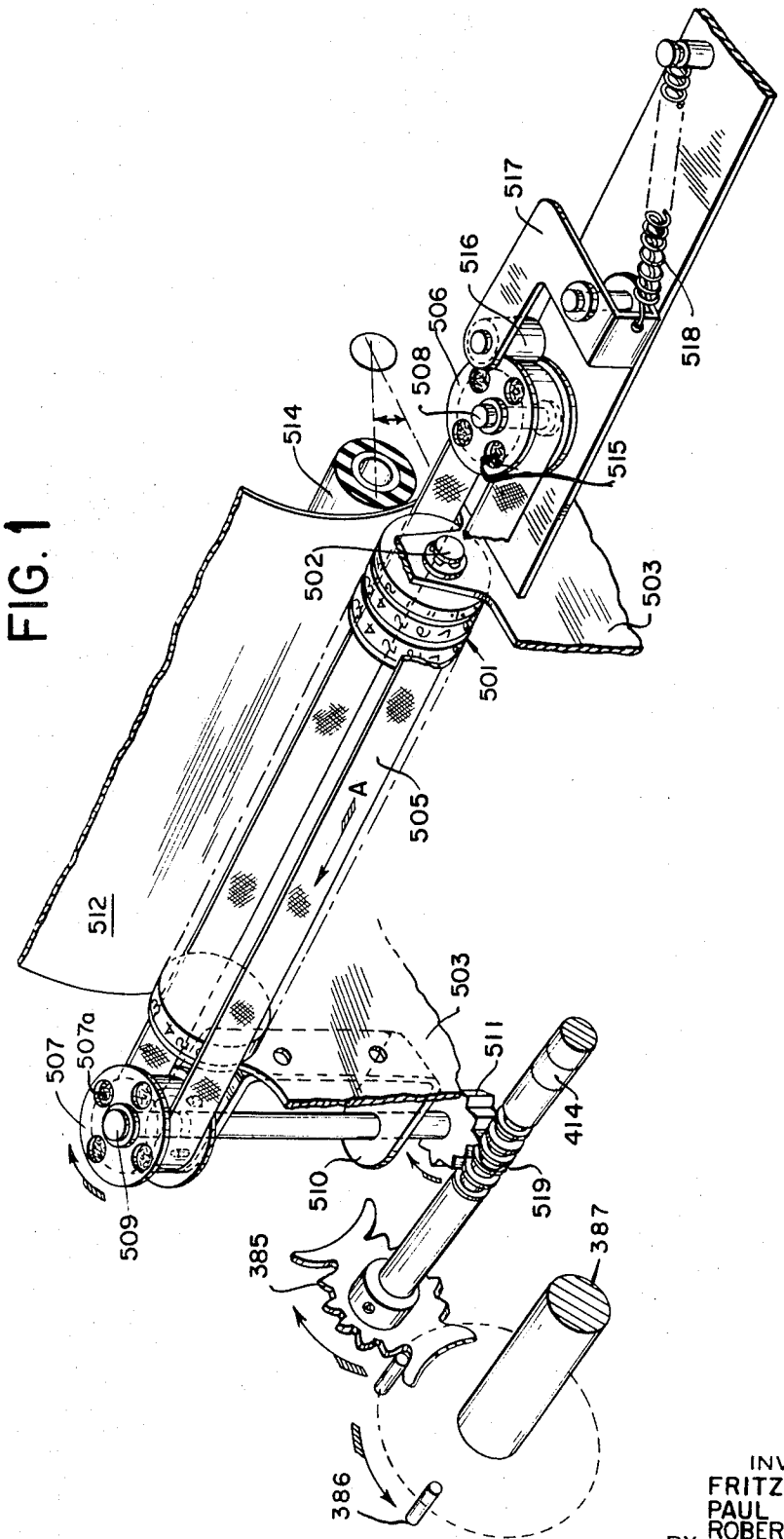


FIG. 1



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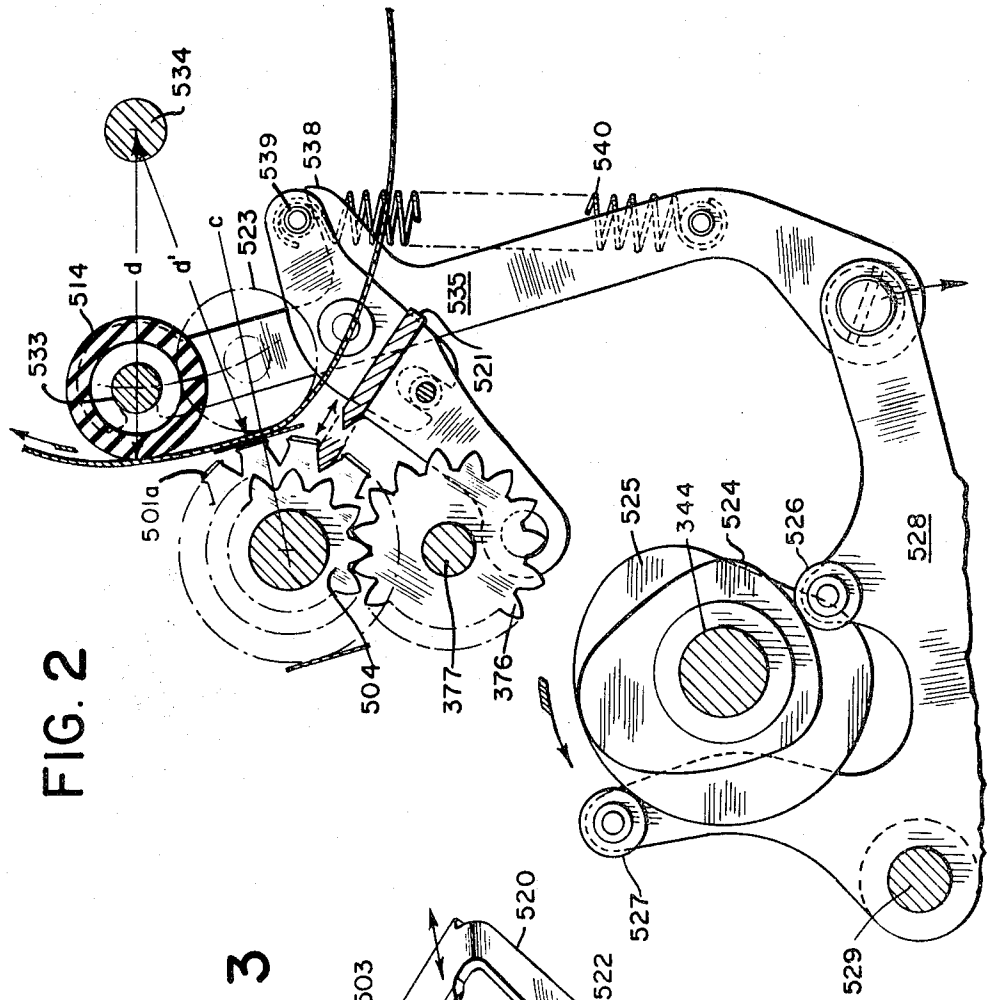

FIG. 2

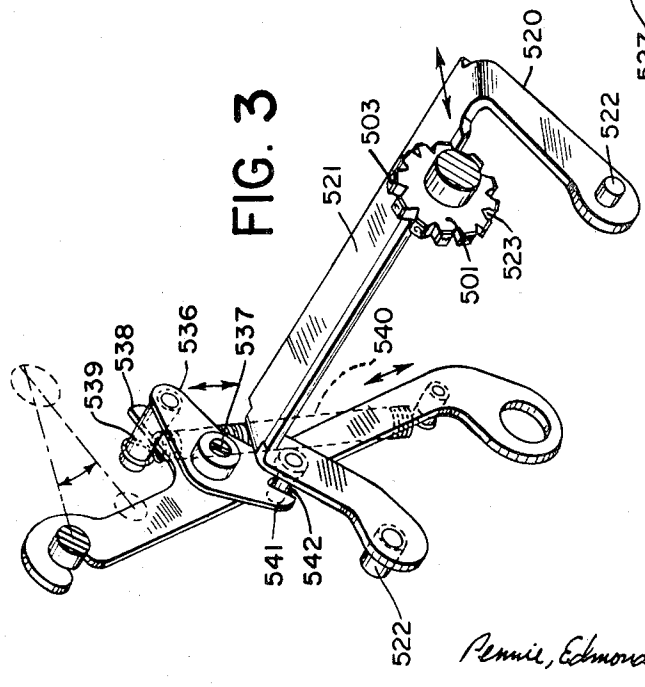

FIG. 3

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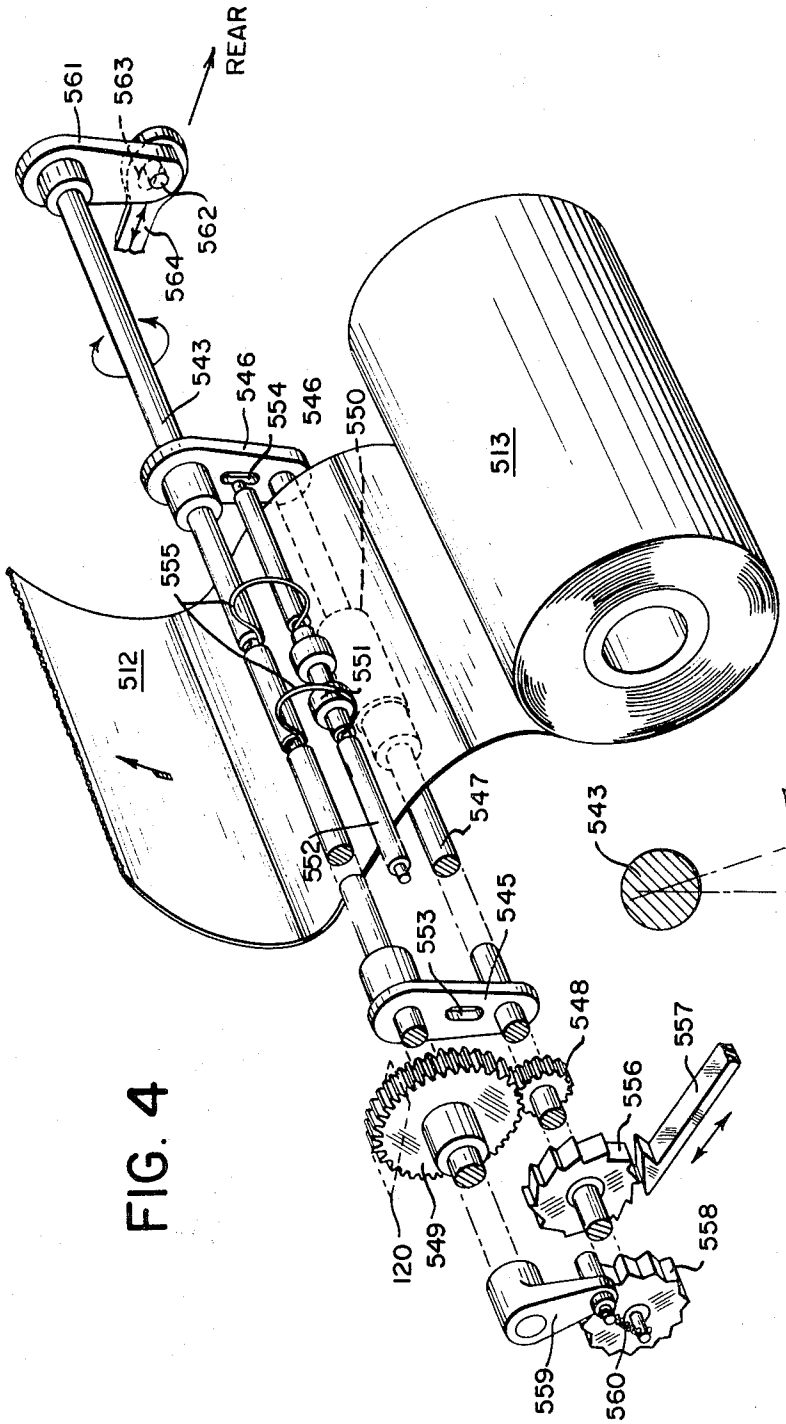

FIG. 4

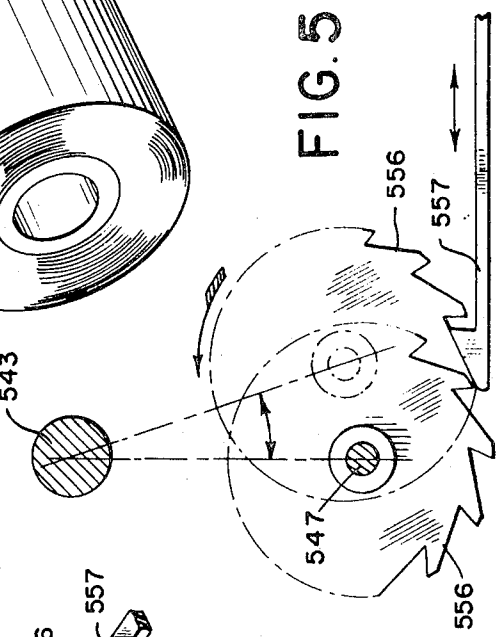

FIG. 5

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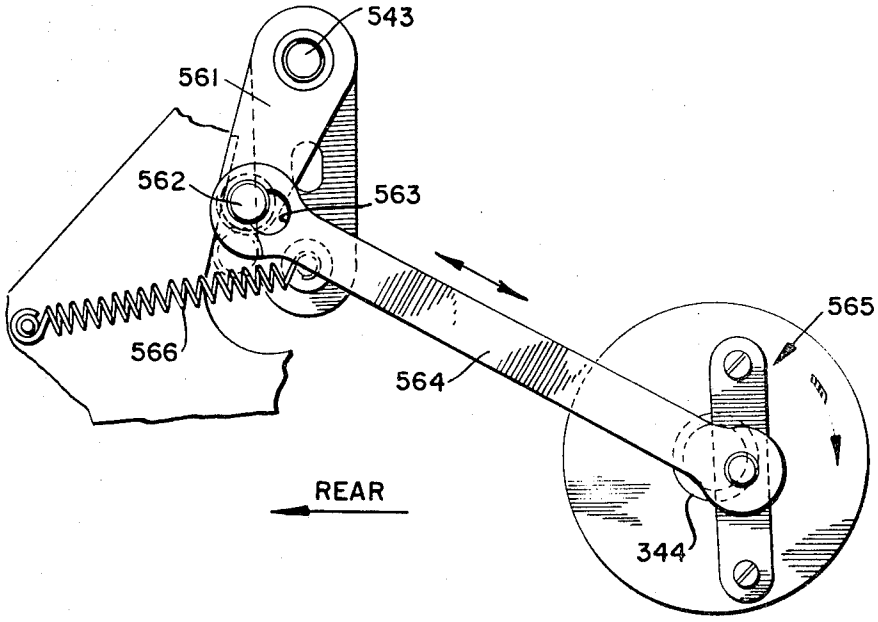
FIG. 6



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RECIPROCABLE PLATEN IN SELECTIVE PRINT WHEEL PRINTING MACHINE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to printing apparatus and, more particularly, to a printing mechanism of the type which is suitable for use in combination with business machines such as calculators, data processing machines, accounting machines, readout devices, and the like.

2. Description of the Prior Art

Heretofore, printing apparatus for business machines and the like were primarily impact-printers which required the printing elements to strike a resilient roller with a record material disposed therebetween, or vice versa. Impact type of printing mechanism has many disadvantages, one of which is high power requirement for the printer. In addition, in impact printing the letters sometimes have a tendency to print unevenly both as to orientation and inking.

SUMMARY OF THE INVENTION

The present invention provides a compact printing mechanism which has low power requirements and provides extremely good print quality, and is suitable for use in combination with a business machine, particularly with calculators and the like. Broadly stated, the printing mechanism includes a set of printing elements rotatably mounted on a first shaft, each printing element having a plurality of print facets and each facet being selectively rotatable to a printing position for each printing operation. A record material is disposed in printing relationship with the printing elements. Adjacent to the printing elements is a print roller which is pivotally reciprocable about an axis parallel to the first shaft, for the printing elements, and spaced apart therefrom at a distance sufficient for the roller to apply a rolling pressure during each reciprocating movement on selected areas of the record material against those facets in the printing position. A power means provides a two-stroke reciprocating movement to the print roller for each printing operation.

Advantageously, the print roller is limited to reciprocation between a first and a second position. The first position is above the print facets in the printing position and the second position is such that a plane including the axis of the print roller and the axis of rotation of the first shaft substantially intercepts the lower surface of the print facets in the printing position. In each printing operation, the print roller reciprocates from the first to the second position and then returns to the first position.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a partially perspective view of the ribbon advance mechanism.

FIG. **2** is a partial sectional view of the drive mechanism for the printing unit.

FIG. **3** is a partial perspective of the aligning mechanism for the printing unit.

FIG. **4** is a partial exploded view, in perspective, of the paper feed mechanism.

FIG. **5** is a partial sectional view, illustrating part of the paper feed mechanism shown in FIG. **4**.

FIG. **6** is a partial side elevation of the drive mechanism for the paper feed.

DESCRIPTION OF THE PREFERRED EMBODIMENT

the printing mechanism of this invention, as broadly described hereinabove, includes a set of print wheels rotatable about a first shaft, a record material, a print roller and power means. The record material preferably is in the form of an inked ribbon disposed in association with a sheet material such as paper. The print roller is rotatable about an axis and pivotally mounted on a second shaft, both parallel to the axis of rotation of the print wheels. The distance between the axes

of the second shaft and the print roller, plus the radius of the print roller, is slightly greater than the distance between the axis of the second shaft and the print facets, by an amount sufficient to provide rolling pressure on the paper and ribbon against the print facets. The power means is used to impart a reciprocating movement to the print roller, providing a rolling pressure on the paper and ribbon aligned with the print facets in the printing position. The operation of the printing mechanism of the present invention will be described with reference to a copending application Ser. No. 655,131, filed July 21, 1967 for U.S. Pat. of Robert C. Hoffman and Fritz Keiser for "Electro Mechanical Data Processing Terminal" filed concurrently herewith, which illustrates how the printing mechanism can be incorporated with a business machine. To facilitate understanding the specification, the same numerical designations are used as appear in the Hoffman et al. application.

RIBBON AND RIBBON ADVANCE MECHANISM

Referring to FIG. **1**, a set of print wheels **501** mounted on and rotatable about a shaft **502** are disposed between the two standing portions of an endless ribbon **505** carried by two rotatable spools **506** and **507**. The spool **506** rotates about a shaft **508** which is fastened to a frame **503**, and spool **507** is fastened to a drive shaft **509** which is mounted in a bracket **510** attached to the frame **503** and which carries a ribbon drive gear **511** at its lower end. A web of paper **512** extending from a paper roll **513** (FIG. **4**) extends between the rear standing portion of the ribbon **505** and a print roller **514** which is formed of a slightly resilient material. In printing, the print roller swings through an arc substantially in the vertical plane to press the paper and the adjacent standing portion of the ribbon **505** against a line of selected print facets of the print wheels **501**.

The ribbon spool **506** has a rim upon which the ribbon rides, in the form of an ink supply pad **515** which transfers ink to the endless ribbon **505**. The ink supply pad **515** is made of a material (*e.g.* woven wool felt) which is designed to maintain a supply of ink furnished thereto in suspension and to transfer ink to the ribbon **505** being pressed thereagainst. The ribbon is made of a material (*e.g.* woven nylon) such that the ink picked up from the ink supply pad **515** is distributed throughout the ribbon by capillary action during the time between its inking and its application in printing. A roller **516** mounted on an arm **517** presses the ribbon against the ink supply pad **515** to assure adequate and even distribution of the ink on the ribbon **505**. The arm **517** is spring loaded against the ink pad **515** by a spring **518** anchored on the frame. The spool **507** includes a rim **507***a* formed of a somewhat absorbent material (*e.g.* woven wool felt) designed to blot any excess ink out of the ribbon **505** as it passes around rim **507***a* and also to aid in evenly distributing the ink in the ribbon.

The drive gear **511** on the ribbon shaft **509** meshes with a worm **519** provided on a shaft **414** which is driven by a star wheel **385** fixed to shaft **414**. Star wheel **385** is driven by drive pins **386** operatively connected to a drive shaft **387**. The drive shaft **387** is operatively associated with a conventional cyclically controlled clutch mechanism (not shown). The above described drive mechanism is detailed to advance the ribbon in the direction of the arrow A, preferably by an amount slightly greater than one character in width, once during each cycle of printing operation. The drive mechanism is explained in detail in the concurrently filed application Ser. No. 655,131 referred to above. By advancing the ribbon in the direction of the arrow A, sufficient time is allowed for complete ink distribution throughout the ribbon, and the spool **507** has a chance to blot any excess ink before the ribbon passes between the print wheels and the print roller.

PRINTING MECHANISM

Print wheel alignment and printing are controlled by a common actuating mechanism shown in FIGS. **2** and **3**. The print

wheel aligner bar **520** comprises a horizontal blade **521** with a V-shaped forward edge pivotable in the vertical plane on two arms which are mounted in the frame of the printer by means of pins **522**. The blade **521** is disposed such that it can move in and out of the V-shaped notches **523** disposed circumferentially about all of the print wheels **501** between adjacent print facets **501***a*. The print wheels are set up by the rotation of a bank of entry gears **376** each of which meshes with a corresponding gear **504** mounted to drive a print wheel. The entry gears **376** may be driven by any suitable means from the associated business machine, as described in greater detail in the copending application for U.S. Pat. of Robert C. Hoffman and Fritz Keiser, mentioned above. At the outset of the printing operation, the aligner bar **520** is moved upwardly so that the blade **521** moves all the way into the V-shaped slots **523**, thereby aligning the print facets **501***a* of all of the print wheels **501**. After printing has taken place (as will be described hereinbelow), the aligner bar is moved out of engagement with the print wheels so that the latter are again free to rotate.

Movement of the aligner bar **520** and the print roller **514** is governed by a pair of complementary drive cams **524** and **525** mounted on a shaft **344**. The complementary cams **524** and **525** act upon respective cam followers **526** and **527** carried by a double-armed rocker member **528** pivoted about a shaft **529** fixed to the frame.

The print roller **514** is preferably pivotally mounted on a bracket (not shown) which may include two rigidly aligned arms carrying a shaft **533** on which the print roller **514** is mounted. The bracket is pivotally mounted on a shaft **534** between two frame members such that the distance *d* from the center of pivot shaft **534** to the outer circumference of print roller **514** is slightly greater than the distance *d'* from the former to the print facets **501***a*, to provide adequate pressure between the print roller and the print facets for a good impression.

The print roller **514** is normally maintained in a first position above the print wheels **501**. When printing occurs, the print roller **514** is swept downward across the type facets of the print wheels **501** so that it rolls across the type facets to a second position, leaving a clear and well delineated image. Printing occurs during the last portion of the downward travel of the print roller **514** and the beginning of its upward return movement. It is important that the print roller not travel so far downward as to disengage from the print facets before its upward return stroke; this prevents slippage between the paper and the print facets, assuring a clear image on the paper.

The print roller **514** is actuated by an actuating member **535** connected between the print roller shaft **533** and the double-armed member **528** and is free to pivot with respect to both of them.

As the shaft **344** is rotated by a power means (not shown) both of the complementary cams **524** and **525** are at all times in contact with the respective cam followers **526** and **527**. During approximately two-thirds of each revolution of the shaft **344**, the cams **524** and **525** are of constant radius with respect to their followers so that the arm **528** is stationary and the print roller **514** remains in its first position. During the remaining third of the shaft cycle, cam **524** increases in radius, forcing the arm **528** and consequently the print roller **514** downward. At the same time, cam **525** decreases in radius (with respect to the cam follower **527**) at a rate corresponding to the increase in radius of the cam **524** (with respect to the cam follower **526**), so that the cams always remain in contact with their respective followers. After the print roller **514** has reached the bottom of its travel and has swept across the preselected print facets **501***a*, the cam **525** begins to increase in radius with respect to the cam follower **527** while the cam **524** begins to decrease correspondingly in radius with respect to the cam follower **526** thereby forcing the arm **528** upward and returning the print roller **514** to its home position. Positive action is thus provided both for the downward and upward movements of the print roller **514**.

To control the action of the aligner bar **520** and to synchronize it with the action of the print roller **514**, the former is controlled by a rocker arm **536**.

The rocker arm **536** is pivoted about a pin **537** mounted on the frame of the printer. The actuating member **535** includes a ledge **538** extending rearwardly at approximately the same level as the pin **537** so that a pin **539** extending from the rocker arm **536** is in a position to rest on the ledge **538**. A spring **540** under tension is mounted between pin **539** and the lower portion of member **535** so as to urge the pin **539** downwardly against ledge **538**. The forward end of the rocker arm **536** is formed as a fork **541** which cooperates with a pin **542** extending from the aligner bar **520**. (FIG. 3).

The print wheel and aligner bar drive mechanisms cooperate in the following manner. The print roller begins in its uppermost, or first, position at which time the pin **539** rests on ledge **538**, the rocker arm **536** thereby being pivoted counterclockwise (as viewed in FIGS. 2 and 3) to hold the aligner blade **521** out of engagement with the V-shaped slots **523** in the print wheels. As arm **528** moves downward, it drives the print roller **514** downward and at the same time lowers the ledge **538**, permitting the spring **540** to pivot the rocker arm **536** clockwise about the pin **537**, thereby driving the blade **521** into engagement with the print wheels. This particular type of action in which the blade **521** is urged into the V-shaped slots **523** by a spring rather than by positive mechanical action is desirable to prevent the aligning action of the relatively sharp blade **521** from cutting into and thus destroying the shape of the V-shaped slots **523**. When the arm **528** again moves upward on the return printing stroke, the ledge **538** lifts rocker **536** against the action of the spring **540** thereby removing the blade **521** from engagement with the print wheels **501**. The above-described elements are positioned and dimensioned such that the print wheels are fully aligned before being contacted by the print roller **514** and remain fixed by the aligner bar **521** until completely out of contact with the print roller **514**.

To provide a clear printout, it is necessary to limit the downward pivotal movement of the print roller to a position such that a plane *c* including the axis of the print roller **533** and the axis of rotation of the print wheel shaft substantially intersects the lower surface of those print facets in the printing position. This position is shown in phantom lines in FIG. 2. Driving the print roller past this position has a tendency to print doubles or otherwise blur the resultant image.

PAPER FEED

The path of the paper **512** which is interposed between the type facets **501***a* and the ribbon **505** (in front of the paper) and the roller **514** (behind it), can be seen from FIGS. 2 and 4.

The paper **511** is preferably positioned so that a number printed can be viewed above the print wheels **501** after each printing operation. The printing position (that is, the position of a portion of the paper **512** when it is contacted by the print wheels) is, however, normally more than one index (paper advance) space below such a viewing position and in the device described in the above-referenced copending application the printing position is two index spaces below the level of such a viewing position. Therefore, after each printout operation, the paper must be indexed upward two spaces so that the number just printed will appear at the viewing position. In order that successive numbers on the paper will be only one vertical (index) space apart, it is therefore necessary to index the paper downward one space before each printout operation, after which it is moved up two spaces.

This is accomplished by the paper feed mechanism shown in FIG. 4, as viewed from the rear of the printer. A paper feed control shaft **543** is mounted between two frame members of the device. The paper roll **513** may rest in any cavity or space provided for it, from which the paper **512** passes forward below the feed control shaft **543**, then passing the viewing position and upward out of the printer. A pair of arms **545** and

546 are fastened to the shaft 543 on opposite sides of the paper 512 and extend downwardly to carry a further shaft 547 substantially parallel with the feed control shaft 543. The arms 545 and 546 are fastened to and rotate with the shaft 543 but the shaft 547 is rotatable independently of them by a gear 548 in mesh with a larger gear 549 rotatably mounted on the shaft 543 and which extends through an opening 120 in the cover of the printer. The shaft 547 carries a friction roller 550 which cooperates with friction rollers 551 carried by a shaft 552 which rides freely up and down in a pair of slots 553, 554, extending vertically in the arms 545 and 546. The shaft 552 is forced downwardly by a pair of loop springs 555 which are fastened to the feed control shaft 543 so that the friction rollers 550 and 551 are urged together.

The paper 512 passes between the friction rollers 550 and 551. A ratchet wheel 556 is mounted on the shaft 547 outwardly of gear 548 and cooperates with a flexible ratchet member 557 which is mounted on the frame. Outwardly of the ratchet wheel 556 a detent gear 558 is mounted on shaft 547. A detent arm 559 is rotatably mounted on the feed control shaft 543 to cooperate with detent gear 558, in the manner shown, and is spring biased toward gear 558 by means of a spring 560 held under tension between the detent arm 559 and shaft 547.

A crank 561 having a pin 562 extending horizontally from its lower portion is fixed to the feed control shaft 543. The pin 562 rides in a lost motion slot 563 in a feed control arm 564 which reciprocates to drive the paper feed mechanism in the following manner.

At the outset, of each printing operation, the feed control arm 564 is in its forward position (toward the front of the printer). Before printout occurs, the arm 564 moves toward the rear of the printer, rotating the feed control shaft 543 counterclockwise (in FIG. 4) and thereby indexing the paper 512 downward one space so that it is properly aligned for printing. During this step, the arms 545 and 546 rotate the entire paper feed mechanism about the feed control shaft 543. When the feed control arm 564 reaches its rearmost position, the ratchet wheel 556 has depressed the ratchet member 557 and has engaged it at approximately the rearmost point in its swing, as shown in FIG. 5. The shaft 547 is prevented from rotating during this portion of the feed mechanism cycle with respect to the arms 545 and 546 by the locking action of the detent gear and arm 558 and 559.

After printing has taken place, the feed control arm 564 again moves toward the front of the device, rotating the feed control shaft 543 clockwise. This movement alone would index the paper 512 upward one space, returning it to its previous position. However, the ratchet wheel 556 has engaged the ratchet member 557 so that clockwise movement of the shaft 547 about the feed control shaft 543 causes a further rotation of the shaft 547 with respect to arms 545 and 546. This turns the friction roller 550 to advance the paper 512 one additional index space for a total of two upward index spaces on the return stroke of the feed control arm 564. Rotation of the shaft 547 with respect to the arms 545 and 546 is permitted on the return, or forward, stroke of the feed mechanism because the torque applied to it by the ratchet member 557 through the ratchet wheel 556 overcomes the resistance supplied by the detent arm and gear 559, 558.

As shown in FIG. 6, the feed control arm 564 is operated by an eccentric mount 565 provided on the shaft 344. A spring 566 biases the arm 564 toward the rear of the device so that the lost motion slot 563 provides a dwell period during which the arms 545 and 546 remain in their rearmost position. Upon further rotation of the shaft 344, the arm 564 returns to its initial forward position, completing the printout operation.

It will be apparent to those skilled in the art that the printer herein shown and described may be used with apparatus other than that shown in the above referenced concurrently filed patent application, and that the invention is not limited to the specific feature of the preferred embodiments described herein, but that various modifications may be made without departing from its scope as defined in the claims.

We claim:

1. A printing mechanism suitable for use in combination with a business machine or the like, said printer comprising:
   a. a set of printing elements rotatably mounted on said printing mechanism for rotation about a first axis, each printing element having a plurality of print facets and each printing element being selectively rotatable to position one of said print facets to a printing line for each printing operation;
   b. a record material supported on said printing mechanism and disposed in printing relationship with said printing elements;
   c. a print roller rotatable about a second axis parallel to said first axis and including means mounting said print roller on said printing mechanism for reciprocal movement from a nonprinting position to a printing position and back to a nonprinting position for each printing operation, and wherein the radius of the print roller and the location of the print roller axis when in a printing position is detailed such that the radius of the print roller is slightly greater than the distance between said print roller axis and the surface of said print facets located at said printing line, in an amount sufficient to provide a rolling pressure on said record material against said print facets; and
   d. control means mounted on said printing mechanisms and operatively associated with said print roller for controlling said reciprocal movement of said print roller, said control means being detailed to effect a limit of movement of said print roller into said print position such that a printing operation is effected during the last portion of travel of said print roller toward said limit and during the first portion of travel of said print roller away from said limit without said print roller being disengaged from said print facets and wherein said reciprocal movement of said print roller is controlled by said control means such that a plane, extending through said print roller axis at any two positions of movement of said print roller through said portions of travel, is located outside the circumference of said printing elements.

2. A printer according to claim 1 wherein the movement of said print roller to said limit position is detailed such that a plane including the axis of the print roller and the rotating axis of said print elements intercepts a lower surface of the print facets when said print roller is in said limit position.

3. A printer according to claim 2 wherein the record material is an inked ribbon in association with a sheet material disposed in a printing position between the printing elements and the print roller.

4. A printer according to claim 2 wherein the print facets at their printing positions are aligned and firmly held therein by a longitudinal element yieldingly engaging said printing elements, said longitudinal element is connected to said power means for providing a reciprocating movement to the print roller by a spring bias linkage for cooperatively reciprocating according to the reciprocating movement of said print roller between the first position where said longitudinal element yieldingly engages the printing elements while the print roller imparts the rolling pressure on the record material against the print facets and a second position away from said printing elements, while the print roller is away from the print facets.