May 14, 1968 W. O. CRALLE, JR., ET AL 3,382,963

PRINTING APPARATUS WITH NO-PRINT FEATURE

Filed Aug. 17, 1966 3 Sheets-Sheet 1

FIG. 1

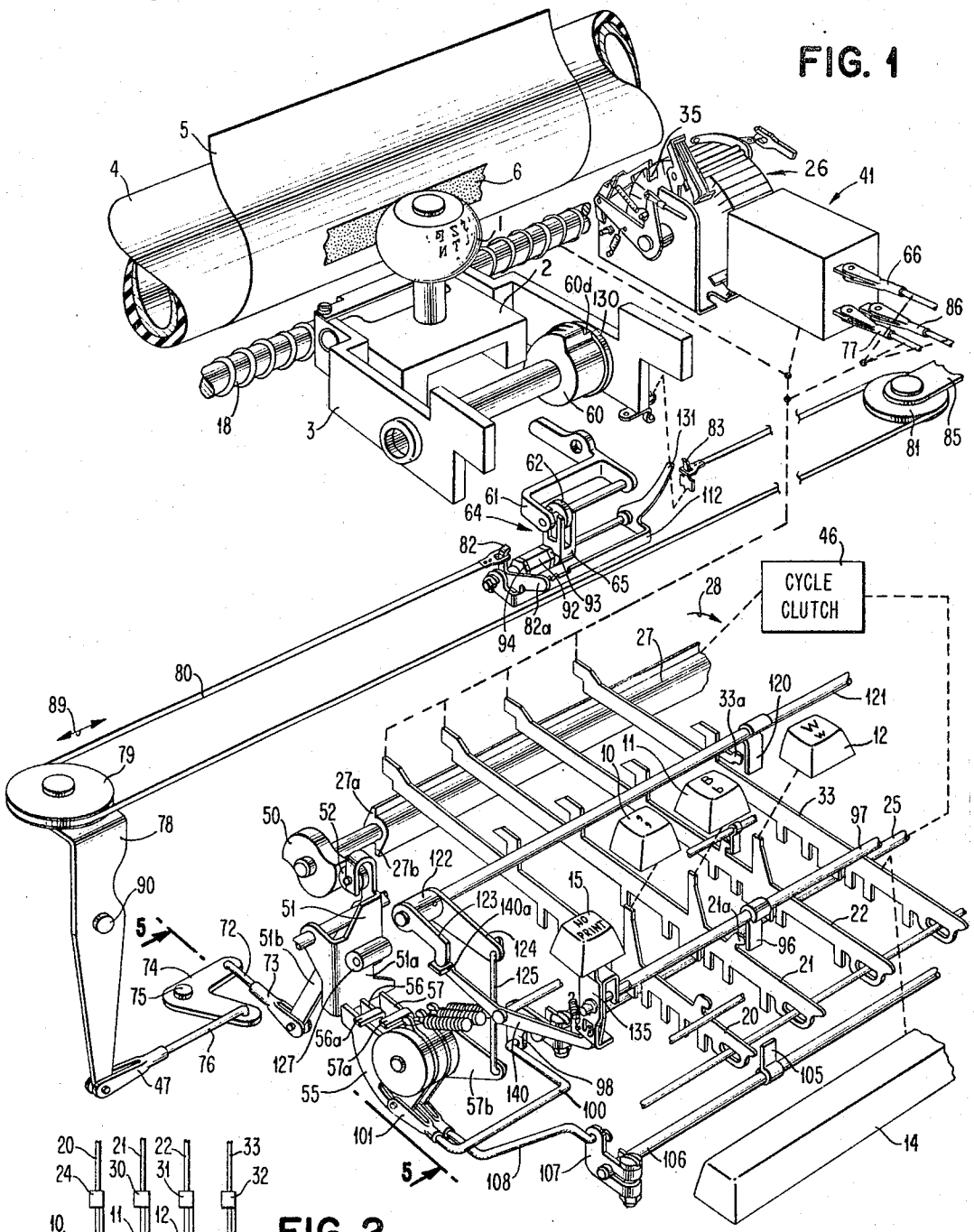
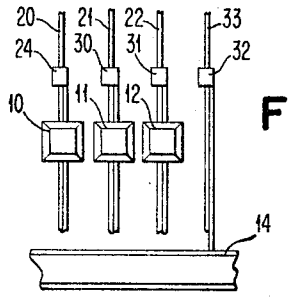


FIG. 2



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PRINTING APPARATUS WITH NO-PRINT FEATURE

Filed Aug. 17, 1966 3 Sheets-Sheet 2

FIG. 3

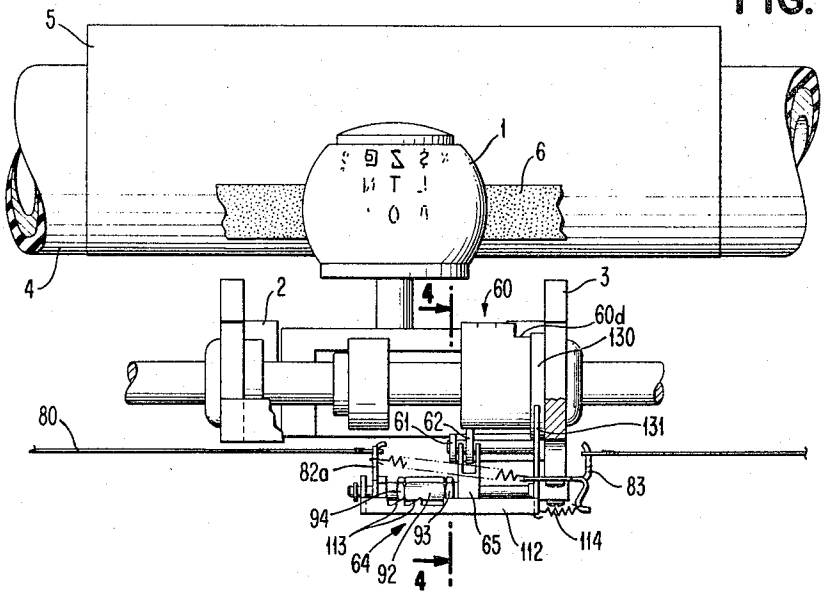


FIG. 4

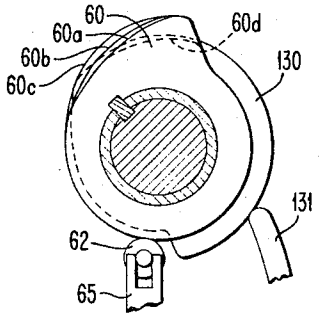


FIG. 5

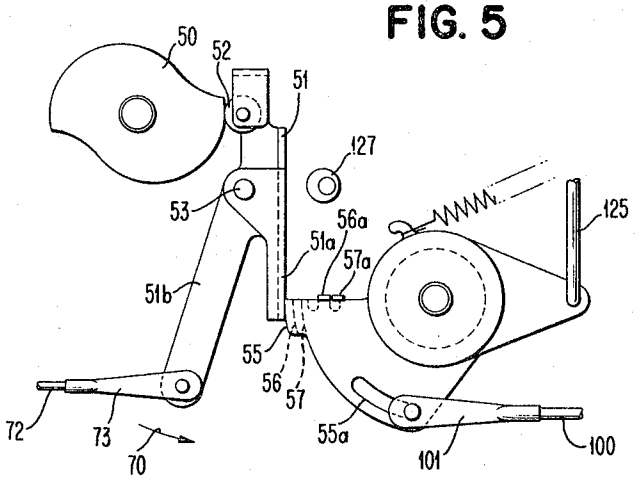
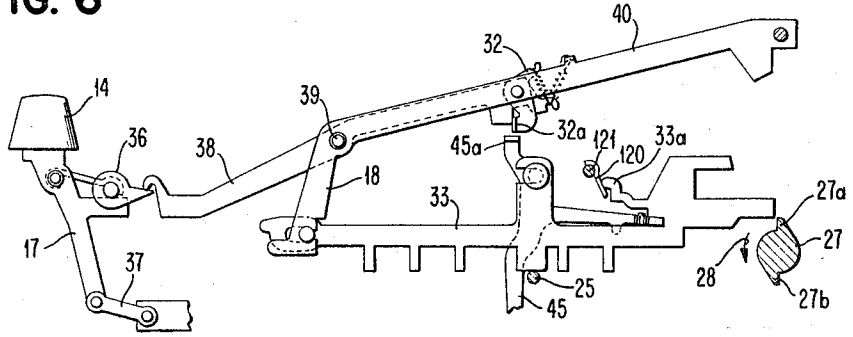


FIG. 6



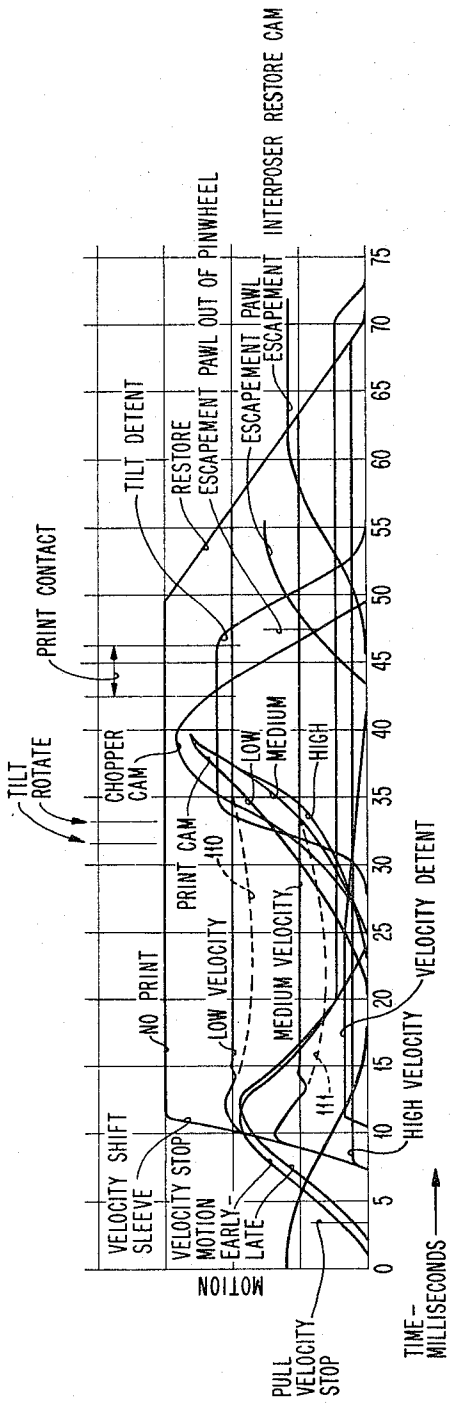


FIG. 9

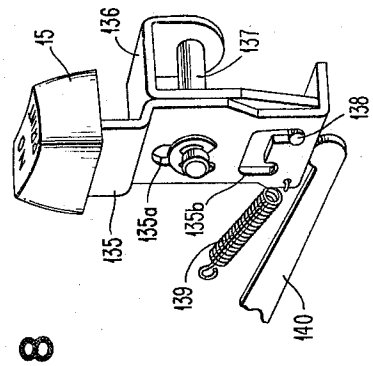


FIG. 8

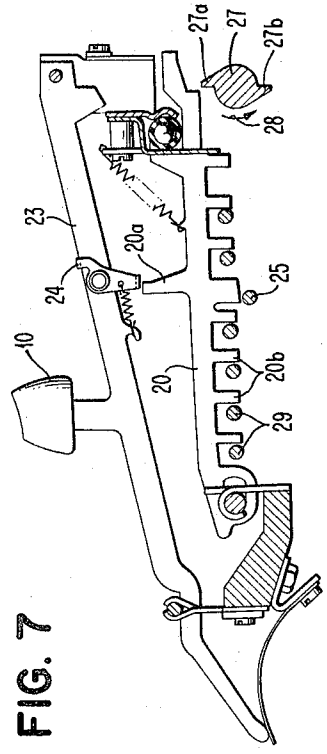


FIG. 7

United States Patent Office 3,382,963 Patented May 14, 1968

3,382,963

PRINTING APPARATUS WITH NO-PRINT FEATURE

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Filed Aug. 17, 1966, Ser. No. 573,020
12 Claims. (Cl. 197—16)

ABSTRACT OF THE DISCLOSURE

The invention relates to control mechanism for a printer to establish several degrees of print impression, as well as a "No Print" condition under certain circumstances, such as a space operation. A print head is actuated against a document with several degrees of impression controlled by a print cam. A No Print condition is established by a No Print cam. The action is determined by the position of a cam roller that is moved back and forth adjacent one of the cams by a pulley and cable. The printer keyboard has character keys, a spacebar, and a No Print key. The keys operate velocity stops of differing lengths which control the extent of movement of a cam follower and therefore, the positioning of the cam roller. The character keys establish low, medium, and high print velocities. When the spacebar is operated, all of the velocity stops are moved out of contact with the follower and the roller is then positioned adjacent the No Print cam. Another key is operated manually to retain the stops out of print control position, thereby establishing a No Print condition for an extended period of time. The apparatus also has undershoot and overshoot control means associated with the cam roller. A pinwheel memory stores escapement values.

Background of invention—field, and prior art

The invention has particular utility in a typewriter with a single element print head, such as that disclosed in U.S. Patent 2,879,876 to L. E. Palmer et al., entitled, "Single Element Printing Machine," and in U.S. Patent 2,919,002 to L. E. Palmer, entitled, "Selection Mechanism for a Single Printing Element Typewriter."

A prior print impression control mechanism for a typewriter of this nature has been disclosed in U.S. Patent 3,239,049 to W. F. Voit, Jr., entitled, "Impression Control Mechanism Automatically Selecting One of a Plurality of Cams."

A related case of interest is the pending application for U.S. Patent Ser. No. 311,373, now U.S. Patent 3,346,086, with W. O. Cralle, Jr., et al., as inventors, and entitled "Single Element Typewriter," filed Sept. 25, 1963, and assigned to the same assignee as the present invention.

The two Palmer patents set forth a typewriter having a single element print head which moves adjacent a document mounted on a stationary platen; that is rotated and tilted for selecting individual characters for printing just prior to actuation against the document during successive printing cycles. A typewriter of this nature is manufactured by International Business Machines Corporation, New York, N.Y., and is sold under the trademark "Selectric." The "Selectric" typewriter is described with considerable detail in the IBM Customer Engineering Instruction Manual on the "Series 72," Form No. 241–5032, copyright 1961. The typewriter is further adapted for input/output (I/O) operations as disclosed in the IBM Customer Engineering Instruction Manuals "Selectric I/O Keyboard Printer," Form No. 241–5159, copyright 1965, and "Selectric I/O Keyboardless Printer," Form No. 241–5248, copyright 1964.

In the basic "Selectric" typewriter described in the Palmer patents and in the manuals, all characters on the print head impact upon the printed page at approximately the same velocity when the print head is actuated, and consequently, each character strikes the document with about the same force. The mechanisms are adjusted to print the majority of characters with the proper impression, the result being that small space area characters, such as the punctuation characters may impress the paper somewhat harder than desired resulting in side printing and possible paper penetration. An important inventive arrangement is described in the Voit patent for establishing varying degrees of impression for the print head prior to printing to insure a more uniform impression on a document. The Voit mechanism includes a plurality of cam elements that are selectively positioned in the printing drive train just prior to printing actuation in each cycle with each cam effecting a different measure of force in driving the print head, depending upon the character just selected. In this manner, the characters having small areas strike the document with somewhat less force while the larger characters, such as "M" and "W," strike the document with a greater force.

A print impression mechanism, such as the Voit mechanism, lends itself admirably to incorporation in a justifying typewriter of the type disclosed in the patent to Cralle et al. The Cralle et al. typewriter has particular utility in the preparation of articles with justified lines for use in newspaper work where it is essential that the printing of characters be performed with uniformity and with efficiency. The Cralle et al. patent describes a proportional escapement mechanism including settable pins arranged in a pin wheel that serve as a memory unit for remembering the past escapement history of an individual line, thereby enabling a typist to backspace and forward space to effect the correction of typographical errors and for revising a line to insure that the line length meets a predetermined standard length that is required for a news article under preparation.

During operation of the Cralle et al. apparatus, and according to the present invention, a typist may wish to type a line of copy in a "No Print" operation during which the single element print head is escaped along the platen as individual characters are selected and functions performed, but the print head is not actuated against the platen and, therefore, no printing occurs. The procedure is followed in order to determine how much space remains in a particular line, whereupon the operator distributes the space as evenly as possible in the spaces occurring between words in the line. Subsequently, the equipment is returned to a "Print" mode to effect the actual printing of characters with the distribution of the excess space being automatically performed so that the line is completely justified and of exactly the required predetermined length.

Under such circumstances, it is desirable to operate functional mechanisms, such as spacebar mechanisms and various selection and printing mechanisms associated with the single element print head to effect electrical or mechanical storage of escapement values related to the functions or individual characters, as an example, but without actually operating the print head.

Even when the print head is actuated during the final printing of a line, it is sometimes desirable to operate mechanisms associated with the print head, such as the spacebar and escapement mechanisms in common with the printing mechanisms, but without actually operating the print head itself. The latter operation may be referred to as a "cyclical No Print" operation since it occurs se-

lectively on a cyclical basis, rather than over an extended perior of time, as under operator manual control.

Objects

Accordingly, it is an object of the present invention to provide printing apparatus with a selectively operable print control mechanism.

Another object of the invention is to provide a print control mechanism that lends itself to automatic and manual control.

A still further object of the invention is to provide a print impression control apparatus that is operable cyclically, on demand, or continuously, as required.

A still further object of the present invention is to provide print control mechanism for a single element printing apparatus.

A further object of the invention is to provide a print control mechanism that is selectively operated for character and function selections.

Also, an object of the invention is to provide a print control mechanism that is operable over a wide range of conditions, from a No Print condition to a high velocity condition.

Summary

In order to accomplish these and other objects of the invention, a printing apparatus is provided with a control mechanism that is selectively operable during individual cycles of printing, that is conditioned, under certain functional conditions, such as spacing, to establish a No Print operation, and that is further operable under manual operator control to be conditioned to a No Print state for as long a period as the operator may require. The apparatus performs its functions in an extremely efficient fashion with high speed and accuracy.

The foregoing and other objects, features, and advantages of the invention will be apparent from the following more particular description of a preferred embodiment of the invention as illustrated in the accompanying drawings.

Description of the drawings

In the drawings:

FIG. 1 illustrates printing apparatus that incorporates a print control arrangement according to the present invention.

FIG. 2 is a top elevation of certain key mechanisms associated with the printing apparatus of FIG. 1.

FIG. 3 is a front elevation of a single element print head and associated print driving mechanisms.

FIG. 4 is a sectional view of various cam elements taken on the line 4—4 in FIG. 3.

FIG. 5 illustrates a portion of a print control mechanism on the line 5—5 in FIG. 1.

FIG. 6 illustrates key controlled mechanisms associated with the spacebar and escapement in the printer of FIG. 1.

FIG. 7 illustrates key oriented mechanisms associated with character selection in the printer of FIG. 1.

FIG. 8 illustrates a manual control for effecting No Print conditioning of the printing apparatus of FIG. 1.

FIG. 9 is a sequence chart illustrating in composite form, various operating conditions encountered in the apparatus of FIG. 1 during a cycle of operation.

Detailed description

FIG. 1 is a diagrammatic representation of a printing apparatus according to the present invention. The apparatus includes a single element print head **1** mounted on a rocker **2** retained in a carrier **3** for movement adjacent a platen **4** having a document **5** positioned for printing. Print head **1** is selectively tilted and rotated by selection mechanisms shown in the Palmer patents previously mentioned and controlled by character keybuttons (keys), such as keybuttons **10**, **11**, and **12**. The keybuttons **10**, **11**, and **12** are representative of a usual typewriter keyboard that also includes a spacebar **14**. In addition to the other keys, the keyboard has a "No Print" key **15**.

FIG. 2 is a plan elevation of the character keys **10**, **11**, and **12**, illustrating associated daubers **24**, **30**, and **31** for operating related interposers **20**, **21**, **22**. Spacebar **14** is shown with dauber **32** and interposer **33**.

Following depression of one of the keys and the tilting and rotating of the print element **1**, the rocker **2** is actuated by means fully disclosed in the Palmer patents to impress the selected character on document **5** through ribbon **6**.

As taught in the Cralle et al. application, the carrier **3** engages a lead screw **18** that is rotated to impart a movement of carrier **3** from left to right in FIG. 1 as printing proceeds and in accordance with the proportional escapement value required for each character or spacing operation, as controlled by mechanisms in the Cralle et al. apparatus, said mechanisms being shown and designated **43** in FIG. 1 of the present case. As individual characters are selected and spacing occurs, clevis links **66**, **77**, and **86** are selectively operated to actuate pin setting members in the block **41** for setting pins **35** in a memory wheel **26**, to thereby store the escapement history of each line as printing progresses. Pins **35**, when they are set, control the reverse movement of carrier **3** in a backspace direction, as well as the forward spacing of carrier **3**, and enable the arcuate positioning of print head **1** in relation to previously printed characters in order to insure accurate corrections.

Associated with the character keys **10**, **11**, and **12** are interposers **20**, **21**, and **22**, respectively. In order to insure clarity of the illustration of FIG. 1, not all of the elements associated with each of the character keys or the spacebar key are shown. However, a typical controlling mechanism for a character key is illustrated in FIG. 7, while the spacebar elements are shown in FIG. 6. The typical character key, such as key **10**, and its associated mechanism will first be described. In FIG. 7, depression of key **10** moves key lever **23** with associated dauber **24** downwardly. Dauber **24** contacts an extension **20***a* on interposer **20** and thereby moves interposer **20** downwardly. Arranged under all of the interposers is a cycle clutch bail **25**. Actuation of any of the interposers downwardly moves the cycle clutch bail **25** downwardly and through mechanism shown in the Palmer patents operates a cycle clutch **46** for rotating a filter shaft **27** to effect operation of the various mechanisms in the printer. Filter shaft **27** is shown in FIGS. 1, 6, and 7. When cycle clutch **46** is tripped, filter shaft **27** rotates in the direction indicated by arrow 28, FIGS. 1, 6, and 7. The filter shaft is rotated 180° during any cycle of operation and a blade portion **27***a* or **27***b* is disposed adjacent the ends of the interposers in such a manner that the depressed interposer is engaged by the blade during its movement, thereby imparting a movement of the interposer toward the front of the printing apparatus which is generally to the right in FIG. 1 and to the left in FIGS. 6 and 7. Actuation of a character interposer by the filter shaft effects engagement of lugs such as lugs **20***b* on interposer **20**, FIG. 7, with bail members **29** that are effective to determine the extent of rotation and tilting of print head **1** for positioning the desired character opposite the printing position prior to the rocking of print head **1** toward document **5**.

In FIG. 6, spacebar **14** is arranged for movement downwardly by cooperation of a key stem **17** with a spacebar cam **36** and an associated stabilizing link **37**. Movement of spacebar **14** downwardly rotates spacebar cam **36** counter-clockwise to act against a link **38** that is associated with a spacebar key lever **40** by pivotal mounting at **39**. As is the case in most electrical typewriters, spacebar **14** can be depressed for a single spacing operation or can be depressed further for a repeat spacing operation. The dauber **32** is mounted on key lever **40** in association with the repeat/non-repeat pawl **18** for

effecting the desired space repetition. Associated with the key lever **40** and the pawl **18** is the spacebar interposer **33** with an interposer latch pawl **45**. The depression of spacebar **14** moves key lever **40** downwardly so that extension **32***a* on dauber **32** contacts the extension **45***a* of the latch pawl **45**. This moves the spacebar interposer **33** downwardly, which thereupon moves the cycle bail **25** down to trip the cycle clutch **46**, FIG. 1, and to thereby effect rotation of the filter shaft **27**. The rotation of filter shaft **27** moves interposer **33** to the left in FIG. 6, and by mechanisms shown as **43**, FIG. 1, and fully described in the Cralle et al. application effects a spacing operation.

Print impression control during character selection

As individual characters are selected by the depression of keys **10**, **11**, and **12**, a print impression control mechanism shown in perspective in FIG. 1 and in other respects in FIGS. 3–5, is effective to establish the proper printing velocity in accordance with the area of each character so that a desirable impression on document **5** is achieved. Mounted for rotation with filter shaft **27** is an impression control cam **50**, FIGS. 1 and 5. Impression control cam **50** is adapted for 180° rotation during each printing cycle and operates against an impression cam follower **51** having a roller **52** co-acting with the cam **50**. Impression cam follower **51** is pivotally mounted at **53**. Cam follower **51** has an extension **51***a* that is arranged in proximity to a high velocity stop **55**, a medium velocity stop **56**, and a low velocity stop **57**.

The velocity stops just noted are effective to control selection of a high, medium, and low velocity portion of a print cam **60**, FIGS. 3 and 4. Associated with print cam **60** is a print cam follower **61** with roller **62** engaging the print cam **60**. Roller **62** is mounted for sliding movement in a slider assembly **64** having an associated slider yoke **65**. For clarity, the various print cam and roller elements are shown separated in FIG. 1. The actual relationship of the elements is illustrated in FIG. 3. Reference is made to the Palmer patents and to the "Selectric" manuals for a description of the printing action with the rocking of rocker **2** under control of print cam follower **61**. The print cam follower **61** is operated in the present instance a predetermined amount that is variable depending upon the size of the character to be printed. It is assumed that the key **10** selects a comma (,) for printing, that key **11** selects an upper case "B" or a lower case "b" and that key **12** selects an upper case "W" or a lower case "w."

The individual characters for keys **10**, **11**, and **12** are assumed to require low, medium, and high velocity printing, respectively. The print cam follower roller **62** is normally positioned adjacent the portion **60***a* of the print cam **60** and if it remains in this normal position, a relatively high velocity of print head **1** is established during printing. To establish a medium velocity, roller **62** is moved adjacent the portion **60***b* which imparts a medium velocity to print head **1** during printing. In order to print at a relative low velocity, roller **62** is moved adjacent the portion **60***c* of print cam **60** which operates the print cam follower sufficiently to impart a low velocity to print head **1** during printing.

Printing of character with high velocity

Assuming that the key **12** for the character "W" is depressed, filter shaft **27** is rotated by cycle clutch **46** and concurrently the impression control cam **50** is also rotated to move the impression cam follower **51** in the direction indicated by arrow **70**, FIG. 5. Impression cam follower **51** moves in the direction of arrow **70** an amount that is determined by the velocity stops **55**, **56**, and **57**. The character "W" requires a high velocity and it is necessary to retain print cam roller **62** adjacent the high velocity portion **60***a* of print cam **60**. In a high velocity situation, all of the velocity stops remain in the condition shown in FIG. 5 so that velocity stop **55** is in position to contact extension **51***a* of the impression cam follower **51** during its movement in the direction indicated by arrow **70**. Follower **51** has a second extension **51***b* that is connected to a link **72** by a clevis **73**. Link **72**, in turn, is attached to one arm of a bell crank **74** that is pivoted at **75**, FIG. 1. The other arm of bell crank **74** is attached by link **76** and clevis **47** to a tape pulley lever **78**. Lever **78** has a pulley **79** with an associated velocity tape **80**. Velocity tape **80** is routed around pulley **79** and another pulley **81** with the ends of velocity tape **80** attached to velocity tape connectors **82** and **83** associated with the velocity slider assembly **64**. Pulley **81** is mounted for rotation on a bracket **85** and maintained in a fairly fixed location throughout operation of the apparatus. Pulley **79** on the other hand, is movable back and forth as indicated by arrow **89** toward and away from pulley **81** as a result of the pivoting of the tape pulley lever **78** about the pivot point **90**. An adjusting screw **92** is initially positioned with jamb nuts **93** and **94** to position yoke **65** in the proper zero reference position with respect to the high velocity portion **60***a* of print cam **60**.

As may be deduced, the retention of the velocity stops **55**, **56**, and **57** in the position shown in FIG. 5 limits the movement of impression cam follower **51** and by linkages just described retains pulley **79** in its leftmost position **51**, thereby retaining follower roller **62** adjacent the high velocity portion **60***a* of cam **60**. Accordingly, following the rotation and tilting of print element **1** to select the character "W," print element **1** is then actuated to print the "W" at a relatively high velocity.

FIG. 9 illustrates the impression selection and the actions of the mechanisms during the printing of a character or a No Print operation. For illustrative purposes, it is assumed that a cycle of printing takes approximately 75 milliseconds shown horizontally in FIG. 9. The relative motions of various elements involved in the printing of a character or in a No Print operation are depicted by motion curves in a vertical direction. To illustrate the actions set forth in the chart of FIG. 9, a cycle of operation wherein high velocity of print element **1** is established will be described. With the selection of the character "W," all velocity stops **55**, **56**, and **57** are maintained in their normal positions to limit the motion of the impression cam follower **51** in order that the roller **62** will remain adjacent the high velocity portion **60***a* of print cam **60**. In FIG. 9, a curve designated high velocity shows the relative movement of the velocity shift sleeve assembly **64** in relation to its home position. Some slight movement does occur. The action is initiated about 4 milliseconds after the beginning of the print cycle at the point designated "Pull Velocity Stop." Two curves are related to the motion of the velocity stops and show the range for an "Early" and a "Late" engagement. With the retention of high velocity stop **55** in position, print cam **60** imparts a high velocity having a relatively rapid rise as indicated by the print cam curve designated "High" in FIG. 9. As the print cam rotates, the rotation and tilting of print element **1** is completed at about 32 milliseconds as indicated by the lines designated "Tilt" and "Rotate." Print element **1** is retained in the position to which it is tilted by a tilt detent that maintains tilt stability from about 35 milliseconds to 47 milliseconds. The actual contact of print element **1** with ribbon **6** and document **5** occurs during the interval from about 42.5 milliseconds to 46.5 milliseconds designated "Print contact." A "Chopper cam" sets the escapement pins **35**, FIG. 1, during the interval indicated by the chopper cam curve in FIG. 9. The movement of the escapement pawl following the printing of a character is shown by the "Escapement pawl" curve. The escapement pawl is moved out of engagement with pinwheel **26**, FIG. 1, at the point indicated at about 47.5 milliseconds in FIG. 9. An escapement interposer restore cam serves to restore the escapement action beginning about 50 milliseconds

and rising to a peak about 60 milliseconds. The restoration of the velocity stops to their normal positions is shown by the line designated "Restore" which slants to the zero line during interval of 50–70 milliseconds.

Since the selection and printing action takes place at high speed, the elasticity of the linkage involved in the print impression control allows the velocity shift sleeve assembly **64** to overshoot and undershoot the desired portion **60***a*, **60***b*, or **60***c* of print cam **60**. In order to dampen the undershoot indicated by the dashed lines **110** and **111** in FIG. 9, a velocity detent **112** is provided. Velocity detent **112** has spaced teeth at **113** that are arranged for engagement with an extension **82***a* on the connector **82** as the slider assembly **64** is moved to the right during the impression control action. The kinetic energy of the slider assembly is absorbed through the engagement of the extension **82***a* with one of the teeth **113** and the action of a detent buffer spring **114**.

Near the end of each cycle, a detent cam **130** cooperates with a detent follower **131** to rotate the same in a clockwise direction and move the detent **112** sufficiently far away from extension **82***a* to permit the restoration of the slider assembly **64** to its home position.

Printing of character with medium velocity

It is now assumed that the character "B," requiring a medium velocity actuation of print element **1** is selected. Following repression of key **11** and interposer **21** and the subsequent actuation of cycle clutch **46** and rotation of filter shaft **27**, interposer **21** is moved toward the front of the apparatus (to the right in FIG. 1). A tab **21***a* on interposer **21** acts against a vane **96** that is fixedly attached to a rotatable bail **97**. Bail **97** extends to the left to a medium velocity bail crank **98** that is mounted to the bail **97**. Attached to one end of bail crank **98** is a medium velocity link **100** having its other extremity attached by a clevis **101** to a slotted portion **55***a* of velocity stop **55**. As a result of the movement of interposer **21**, link **100** is moved to the right in FIGS. 1 and 5 and pulls the high velocity stop **55** downward out of contacting position with extension **51***a* of impression cam follower **51**. Velocity stops **56** and **57** remain in position at this time.

The impression is now under control of velocity stop **56** which, as can be seen in FIG. 5, is cut slightly more to the right than velocity stop **55**. Accordingly, extension **51***a* on cam follower **51** is permitted to move further to the right in the direction of arrow **70** in FIG. 5 and through the linkages previously discussed rotates the lever **78** about pivot point **90** thereby moving pulley **79** toward the right in FIG. 1. The movement of pulley **79** is such that roller **62** is now positioned opposite the medium velocity portion **60***b* of print cam **60**. Following the selection of the character "B," which is taking place concurrently with the impression control changes, print element **1** is actuated against document **5** and due to the co-action of follower **62** and cam portion **60***b*, a medium velocity of print element **1** is established for the character "B."

The graph in FIG. 9 shows the actions of the printing mechanism when the medium velocity stop **56** is selected. The print cam action and velocity are represented by the print cam line designated "Medium." Except for the changes in velocity exerted by stop **56**, the printing action is comparable to that described in connection with the selection and the printing of the character "W" that occurred at high velocity.

Printing of character with low velocity

The comma character (,) is now selected for printing and requires a low velocity operation of print element **1**. Depression of key **10** moves interposer **20** and operates cycle clutch **46** and filter shaft **27**, as before. Interposer **20** is moved to the right (left in FIG. 7), operates against the various bails **29** to select the rotation and tilting for print element **1**, and also moves into contact against a vane **105**, FIG. 1, that is fixedly attached to a bail **106** for establishing low velocity of print element **1**. Bail **106** is secured to a bail crank **107**. Rotation of vane **105** clockwise in FIG. 1 also rotates crank **107** clockwise and crank **107** pulls an attached low velocity link **108** to the right in FIG. 1. Link **108** is attached to the medium velocity stop **56** and pulls stop **56** out of position so that contact with follower extension **51***a* is prevented. Velocity stop **56** has an extension **56***a*, FIG. 5 that overlaps the high velocity stop **55**. Therefore, movement of velocity stop **56** downwardly in FIG. 5 will effect movement of stop **55** downwardly at the same time. The action just described leaves the low velocity stop **57** in position for contact with follower extension **51***a* during the cycle. Follower **51** thereupon is able to move further to the right in the direction of arrow **70** in FIG. 5, pulley **79** is moved further to the right in FIG. 1, and follower roller **62** is thereupon positioned opposite the low velocity portion **60***c* of print cam **60**. During the actuation of print element **1** following the rotate and tilt selection of the comma character (,), print element **1** is thereafter actuated under control of cam portion **60***c* to establish a low velocity printing of the character (,).

The low velocity selection required for the printing of the comma character (,) is illustrated in FIG. 9, as for the other velocity stops. The print cam motion is more gradual during a low velocity operation as indicated by the curve for the print cam designated "Low." The selection of the character, the printing action, and the restoration of the mechanisms occurs in a manner comparable to that encountered during the printing of the characters "W" and "B."

Cyclical No Print action

The mechanism disclosed herein provides for a No Print action of print element **1**, under certain circumstances. As described in the Cralle et al. application, the depression of spacebar **14** operates the pin wheel assembly **26** to store the value of the escapement for later use during the justification of a line and results in the movement of the carrier **3** and print element **1** to the right either **2** or **3** spacing increments. For purposes of illustration, it is assumed that the apparatus has only a single spacebar **14** that moves carrier **3** a predetermined number of escapement increments. In a typical application, means will be provided, not shown, for adjusting the actual number of spacing increments for carrier **3** under operator control with, for example, a range of 3 to 9 increments established by rotation of a dial and any of the selected increments being effected by movement of the single spacebar **14**. A dial arrangement of this nature is shown in U.S. Patent 2,294,722, R. D. Dodge, entitled, "Typewriting Machine."

As indicated in the Cralle et al. patent, the escapement mechanism utilizes certain common driving elements including the cycle clutch **46** and the filter shaft **27** and requires an interposer **33** as for any character that is selected to be printed. However, in the case of a spacing operation, no character is actually selected for printing, and it is desirable to deactivate print element **1**. This is accomplished in the following manner.

In FIGS. 1 and 6, interposer **33** has an extension **33***a* that is adapted to contact a vane **120** that is mounted to a No Print bail **121**. When filter shaft **27** rotates, interposer **33** is moved to the right in FIG. 1. Extension **33***a* contacts vane **120** to rotate No Print bail **121** counterclockwise. Attached to the leftmost extremity of bail **121** is a No Print bail crank **122** having two extensions **123** and **124**. Attached to extension **124** is a link **125** that is connected at its other extremity to an extension **57***b* of the low velocity stop **57**. Rotation of No Print bail **121** and bail crank **122** counterclockwise pulls link **125** upward and rotates velocity stop **57** sufficiently counterclockwise to move it out of contacting engagement with impression

cam follower **51**. Stops **55** and **56** are also rotated counterclockwise and pulled out of the way with respect to follower **51** by extensions **56***a* and **57***a*.

Under these circumstances, therefore, none of the velocity stops **55**, **56**, or **57** is in position for engagement with the impression cam follower **51**. When filter shaft **27** and impression cam follower **50** rotate during the spacing cycle, follower **51** is free to move to the furthest extent permitted by a stop eccentric **127**, FIGS. 1 and 5. With the movement of follower **51** to the extent indicated, pulley **79** moves to the right in FIG. 1 a distance sufficient to place roller **62** opposite the No Print cam location **60***d*. The No Print cam portion **60***d* may have no rise or negligible rise so that no driving force is imparted through the drive train to print element **1** during the cyclical operation of the mechanisms. Therefore, the print driving mechanisms associated with the interposers are effective to operate and restore the keyboard as usual and to enable the storing of the number of escapement units occurring as a result of depression of spacebar **14**, but do not operate the print element **1**, as is normally the case when a character to be printed is selected.

In FIG. 9, the motions involved are simply indicated by the straight line designated "No Print" with the understanding that no motion is imparted to the print element **1** as is normally the case during the printing of a character. The "Tilt," "Rotate," and "Print contact," areas in FIG. 9, are also inapplicable in the present instance.

Manual control of No Print

Privision is made in the present apparatus for controlling the impression mechanism to establish a "No Print" mode for an extended length of time. The manual control is in the form of a "No Print" keybutton **15**, FIGS. 1 and 8. "No Print" keybutton **15** has an associated keylever **135** mounted with a spacer element **136** for rotation and linear movement on a shaft **137**. No Print keylever **135** has a slotted portion **135***a* that enables the aforementioned movements. Another slotted portion **135***b* cooperates with a pin **138** extending from a spacer **137**. The slotted portion **135***b* has two home positions. The lower end of No Print keylever **135** is normally maintained toward the rear of the apparatus by a restoring spring **139**.

The No Print key is arranged to permit a No Print operation for a single cycle, or for multiple cycles of operation, as required. Associated with the No Print keylever **135** is a transfer crank **140**. Crank **140** has an extension **140***a* arranged for engagement with the extension **123** associated with the No Print bail crank **122**, previously noted. To effect a No Print mode for a single cycle, No Print keybutton **15** is depressed, thereby depressing keylever **135** and transfer crank **140** downwardly. The extension **140***a* of crank **140** moves upwardly, rotates the No Print bail crank **122** in a counterclockwise direction, moves all of the velocity stops **55**, **56**, and **57** out of contacting engagement with follower **51**, and enables the movement of the roller **62** opposite the No Print cam portion **60***d*.

If no printing required during a plurality of cycles of operation of the apparatus, the No Print key **15** and keylever **135** are moved toward the rear of the machine, pivoting keylever **135** counterclockwise about shaft **137** and enabling the engagement of pin **138** with the rear slot in the slotted portion **135***b*. Upon such engagement, the No Print keylever **135** is maintained in a downward position for an indefinite period of time until restored by the operator. The transfer crank **140** is also retained downwardly, and the No Print bail crank **122** is maintained in a counterclockwise rotated condition, all of the velocity stops **55**, **56**, and **57** are maintained out of engagement with follower **51**, and no actuation of print element **1** occurs because roller **62** is positioned opposite the No Print cam **60***d*.

The foregoing No Print mode over a plurality of cycles is useful, as indicated before, during preliminary typing efforts in connection with the justification of printed matter on document **5**.

Referring to FIG. 9, the No Print action established under manual control appears similar to the No Print action established in a cyclical manner as during the operation of the spacebar **14**, previously described.

It is apparent from the preceding description that a simplified impression control mechanism has been provided with a wide range of velocity control conditions from a No Print condition to a high velocity condition, and having provision for both automatic cyclical control and manual control, as required.

Numerous modifications can be made in the apparatus. For instance, the printing apparatus may be used for Input/Output with the character selecting and functional mechanisms operated automatically by electromagnets, rather than manually as shown. As another example, a single velocity for characters, with a No Print mode for functions, may be provided, rather than high, medium, and low velocities. Also, the apparatus may be normally maintained in a No Print mode and all velocities selected when characters are to be printed rather than normally maintained in a high velocity mode.

While the invention has particularly shown and described with reference to a preferred embodiment thereof, it will be understood by those skilled in the art that various changes in form and detail may be made without departing from the spirit and scope of the invention.

What is claimed is:

1. Printing apparatus, comprising:

selection means for selecting characters for printing and functional operations to be performed;

printing means operable to print characters selected by said selection means;

means for effecting functional operations normally not requiring actuation of said printing means, such as spacing;

print impression control means for establishing a plurality of predetermined velocities for said printing means according to the characters selected and a No Print condition of said printing means, said impression control means including a control cam, associated linkages, a plurality of print cam means related to the velocity required for any character selected and a No Print cam with rise in the range of none to negligible, a cam follower, and further including a fixed stop associated with said No Print cam, and a group of movable settable velocity stops associated with said control cam and selectively positionable to a first state with at least one stop positioned for establishing a driving connection from said control cam to move said follower adjacent the print cam means that imparts the velocity required for any character selected, and positionable as a group to a second state wherein all movable stops are moved out of driving relation to said control cam, but a No Print connection is established under control of said fixed stop to move said follower adjacent said No Print cam;

common drive means for driving said selection means, said printing means, said print impression control means, and said functional means, on a selective basis;

a plurality of actuatable character by mechanisms for initiating character selection, and functional key mechanisms for initiating functional operations, both of said types of key mechanisms also initiating operation of said common drive means, as required;

and means for selectively and positively positioning said velocity stops to said first state during character printing cycles and for positively positioning said velocity stops to said second state during functional cycles.

2. The apparatus of claim 1, wherein:
said printing means comprises a single element print head movable from a rest position to a printing position against a document to be printed.

3. The apparatus of claim 1, wherein:
said print impression control means establishes three velocities of said print element, designated respectively, high, medium, and low, in addition to said No Print condition.

4. Printing apparatus, comprising:
selection means for selecting characters for printing and functional operations to be performed;
printing means operable to print characters selected by said selection means;
means for effecting functional operations normally not requiring actuation of said printing means, such as spacing;
impression control means for establishing a plurality of predetermined velocities for said printing means according to the characters selected, said impression control means including a cam, associated linkages, a cam follower, and a plurality of print cam means related to the velocity required for any character selected, said print cam means including a No Print portion with rise in the range of none to negligible;
common drive means for driving said selection means, said printing means, said print impression control means, and said functional means, on a selective basis;
a plurality of actuatable character key mechanisms for initiating character selection and functional key mechanisms for initiating functional selection, both of said types of key mechanisms also initiating operation of said common drive means, as required;
connecting means for rendering said impression control means effective to control the velocity of said print element during character printing cycles, and for deactivating said impression control means to thereby establish a No Print condition of said printing means during functional operations of said apparatus;
means associated with said character key mechanisms including selectively settable velocity stops positioned in proximity to said cam follower for controlling the same during character printing cycles, said velocity stops having projections of varying rise to control the extent of movement of said cam follower, each velocity stop being supplied with successively less rise from highest to lowest velocity, and wherein said means associated with said character key mechanisms is effective to maintain the highest rise stop in position when a high velocity is required, to move all stops out of the way except a required lower velocity stop as successive lower velocities are required during character selection to thereby establish a driving condition to position said cam follower adjacent the print cam that imparts the velocity required for the character selected;
and means associated with said functional key mechanisms effective to move all of said velocity stops out of contacting engagement with said cam follower to thereby establish a connection to position said cam follower adjacent the No Print portion of said print cam means when a No Print condition is to be established.

5. Printing apparatus, comprising:
selection means for selecting characters for printing and functional operations to be performed;
printing means operable to print characters selected by said selection means;
means for effecting functional operations normally not requiring actuation of said printing means, such as spacing,
impression control means for establishing a plurality of predetermined velocities for said printing means

according to the characters selected, said impression control means including a cam, associated linkages, a cam follower, and a plurality of print cam means related to the velocity required for any character selected;
common drive means for driving said selection means, said printing means, said print impression control means, and said functional means, on a selective basis;
a plurality of actuatable character key mechanisms for initiating character selection, and functional key mechanisms for initiating functional selection, both of said types of key mechanisms also initiating operation of said common drive means, as required;
connecting means for rendering said impression control means effective to control the velocity of said print element during character printing cycles, and for deactivating said impression control means to thereby establish a No Print condition of said printing means during functional operations of said apparatus;
means associated with said character key mechanisms including selectively settable velocity stops positioned in proximity to said cam follower for controlling the same during character printing cycles to thereby establish a driving connection to position said follower adjacent the print cam that imparts the velocity required for the character selected;
and manually operable No Print means that is selectively settable to deactivate said print impression control means in a selective manner and irrespective of the functional or character printing operations required.

6. The apparatus of claim 5, wherein:
said No Print means is operable to two conditions, the first condition establishing a temporary No Print mode and the second condition establishing a No Print mode for an extended period of time, until said No Print means is released.

7. Printing apparatus, comprising:
selection means for selecting characters for printing and functional operations to be performed;
printing means operable to print characters selected by said selection means;
means for effecting functional operations normally not requiring actuation of said printing means, such as spacing;
impression control means for establishing a plurality of predetermined velocities for said printing means according to the characters selected and including a No Print position, said impression control means including a cam, associated linkages, a cam follower, and a plurality of print cam means related to the velocity required for any character selected;
common drive means for driving said selection means, said printing means, said print impression control means, and said functional means, on a selective basis;
a plurality of actuatable character key mechanisms for initiating character selection, and functional key mechanisms for initiating functional selection, both of said types of key mechanisms also initiating operation of said common drive means, as required;
connecting means for rendering said impression control means effective to control the velocity of said print element during character printing cycles, and for deactivating said impression control means to thereby render said printing means inactive during functional operations of said apparatus;
means associated with said character key mechanisms including selectively settable velocity stops positioned in proximity to said cam follower for controlling the same during character printing cycles to establish a driving connection to position said cam fol-

lower adjacent the print cam that imparts the velocity required for the character selected;

and means effective during operation of said impression control means to control overshooting or undershooting of said impression control means.

8. The apparatus of claim **7**, wherein:

said undershoot and overshoot control means comprises a detent associated with the impression control means, said detent being effective in each cycle to dampen the movement of the impression control means following the selection of impression velocity required and prior to actuation of said printing means.

9. The apparatus of claim **8**, further comprising:

cam control means for restoring said detent means following a printing operation during each printing cycle of operation.

10. Printing apparatus, comprising:

selection means for selecting characters for printing and functional operations to be performed;

printing means operable to print characters selected by said selection means;

means for effecting functional operations normally not requiring actuation of said printing means, such as spacing;

impression control means for establishing a plurality of predetermined velocities for said printing means according to the characters selected, said impression control means including a cam, associated linkages, a cam follower and a plurality of print cam means related to the velocity required for any character selected;

common drive means for driving said selection means, said printing means, said print impression control means, and said functional means, on a selective basis;

a plurality of actuatable character key mechanism for initiating character selection, and functional key mechanisms for initiating functional selection, both of said types of key mechanisms also initiating operation of said common drive means, as required;

connecting means for rendering said impression control means effective to control the velocity of said print element during character printing cycles, and for deactivating said impression control means to establish a No Print condition of said printing means during functional operations of said apparatus;

means associated with said character key mechanisms including selectively settable velocity stops positioned in proximity to said cam follower for controlling the same during character printing cycles to establish a driving connection to thereby position said cam follower adjacent the print cam that imparts the velocity required for the character selected;

a selectively settable escapement memory means for storing the escapement history of individual lines as printing and functions progress; and

means operable under control of said character key mechanisms, said functional key mechanisms and said common drive means for setting said escapement memory means as required, during printing and No Printing modes of operation.

11. The apparatus of claim **10**, further comprising:

proportional escapement means for relatively moving said printing means and a document to be printed, proportional increments that are dependent upon the character selected for printing or the functional operation performed; and wherein,

said memory means stores said proportional increments.

12. The apparatus of claim **11**, wherein:

said memory means comprises a pin wheel memory having pins settable to a state representative of escapement increments as printing and functional operations occur.

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