

[54] **BI-DIRECTIONAL SPACING MECHANISM FOR A PRINTER INCLUDING A PROPORTIONAL SPACING PRINTER**

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[22] Filed: **June 30, 1970**

[21] Appl. No.: **51,124**

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[52] U.S. Cl. ....197/84 R, 197/15, 197/91, 197/94, 197/176

[51] Int. Cl. ....**B41j 19/58**

[58] Field of Search.....197/16, 18, 64, 82, 84, 84 A, 197/84 B, 85, 86, 87, 88, 89, 91, 92, 94, 96, 176, 183, 15

[57] **ABSTRACT**

A character printing position is displaced by various increments in forward and reverse directions by premeasured motion delivered to a movable letter spacing member through a shuttling control rack. A variable stop member is moved to select the desired amount of spacing movement by arresting the control rack, which is yieldably driven via a spring through a potential stroke during each cycle.

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**18 Claims, 8 Drawing Figures**

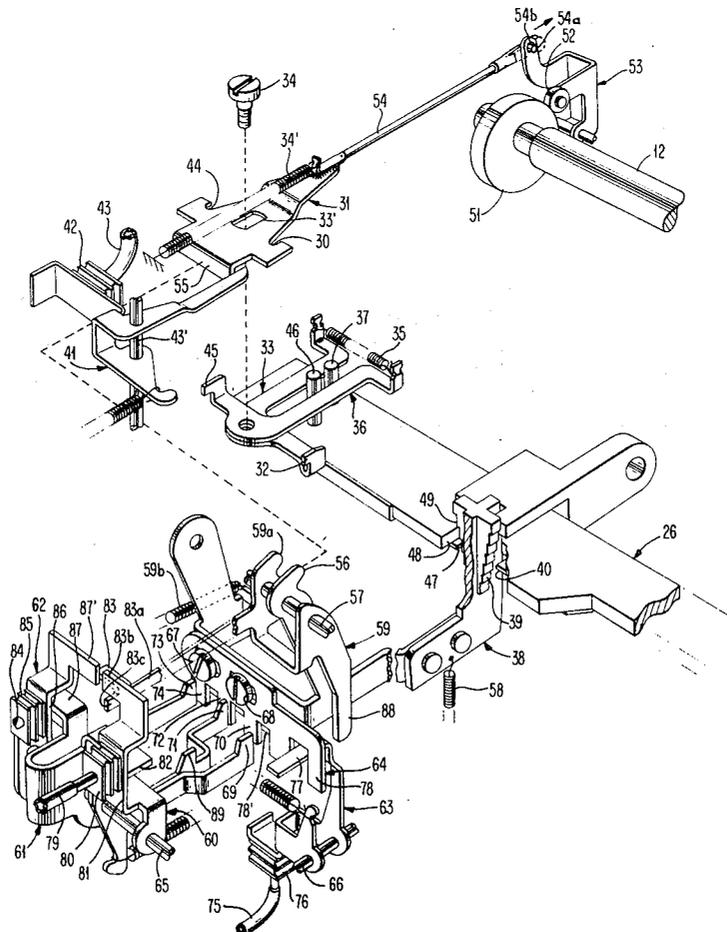
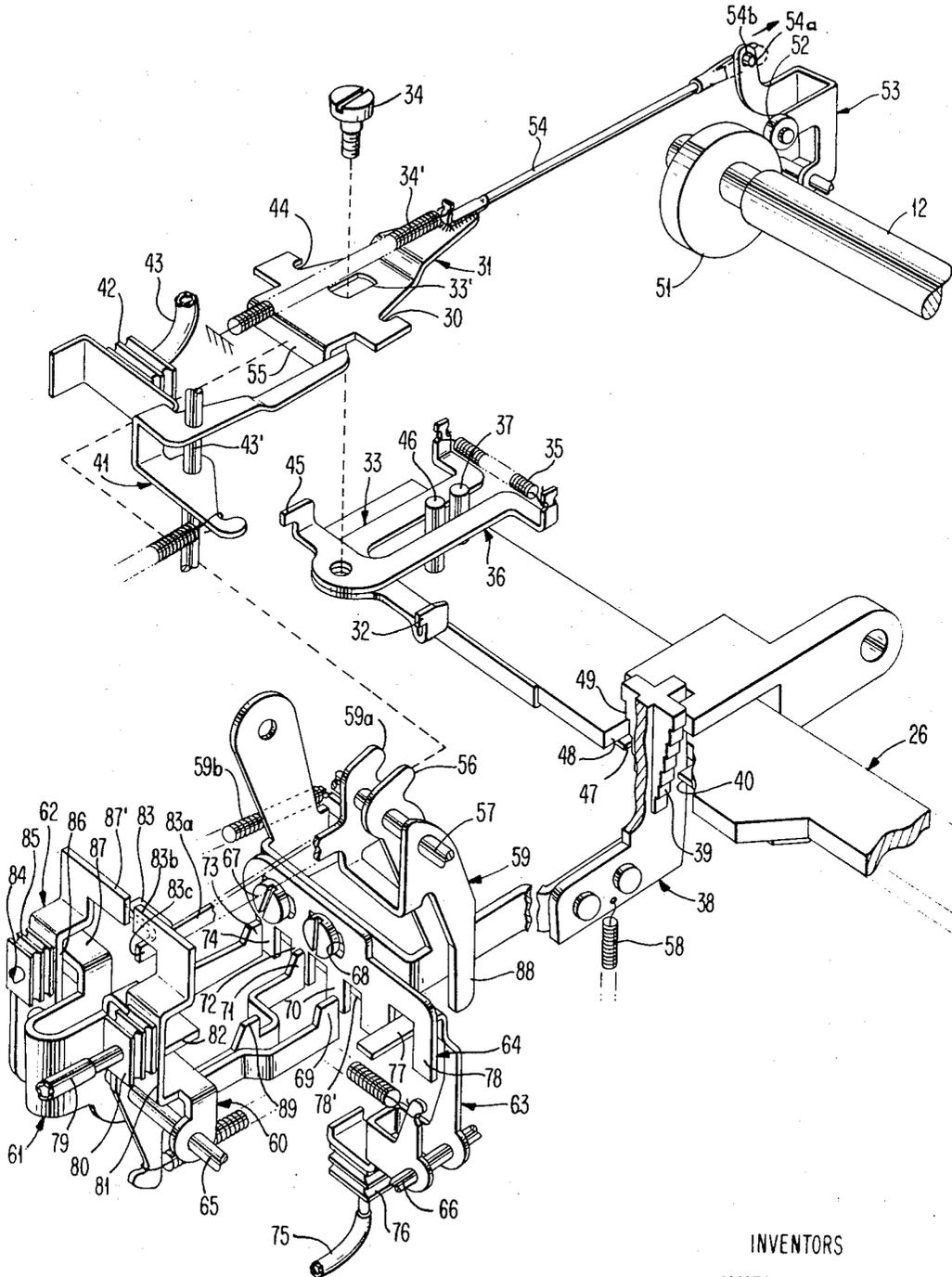


FIG. 1A



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FIG. 2

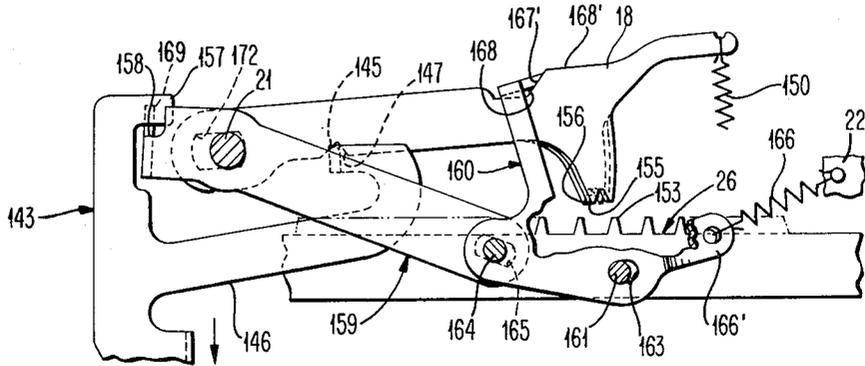


FIG. 3

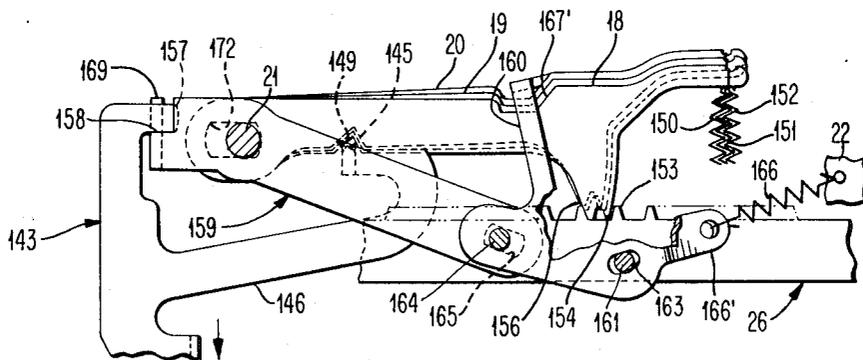


FIG. 4

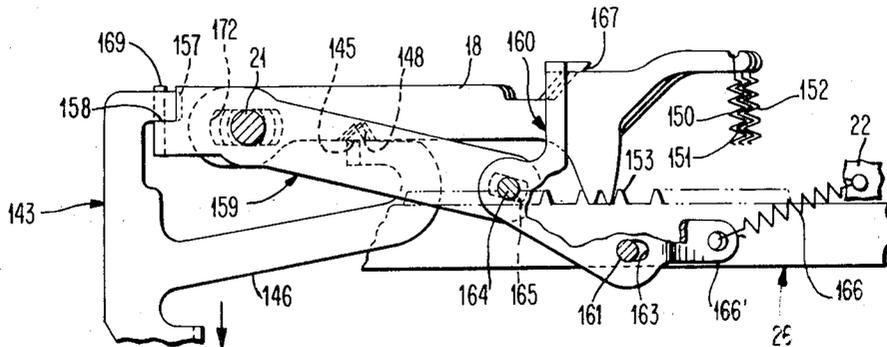


FIG. 6

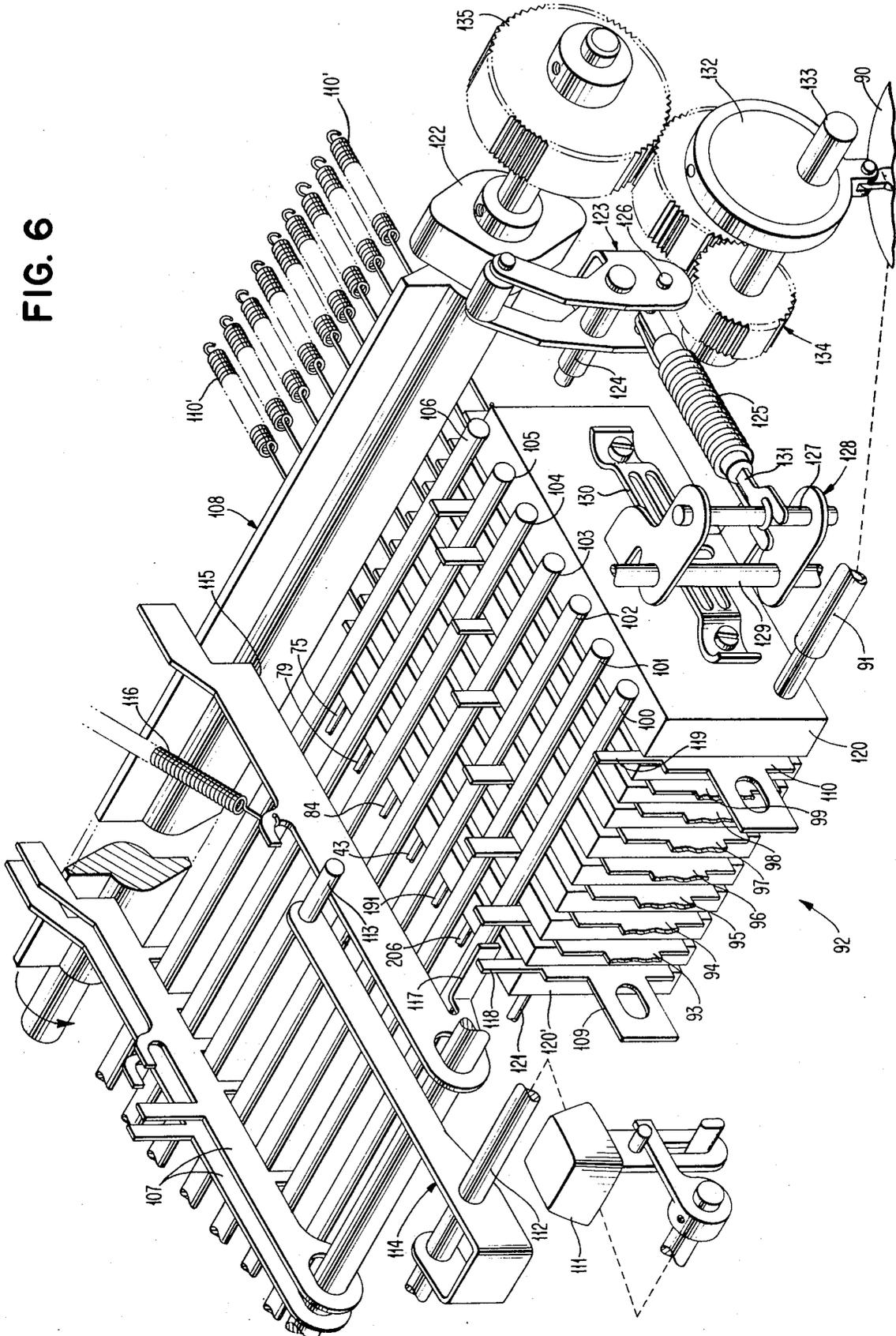
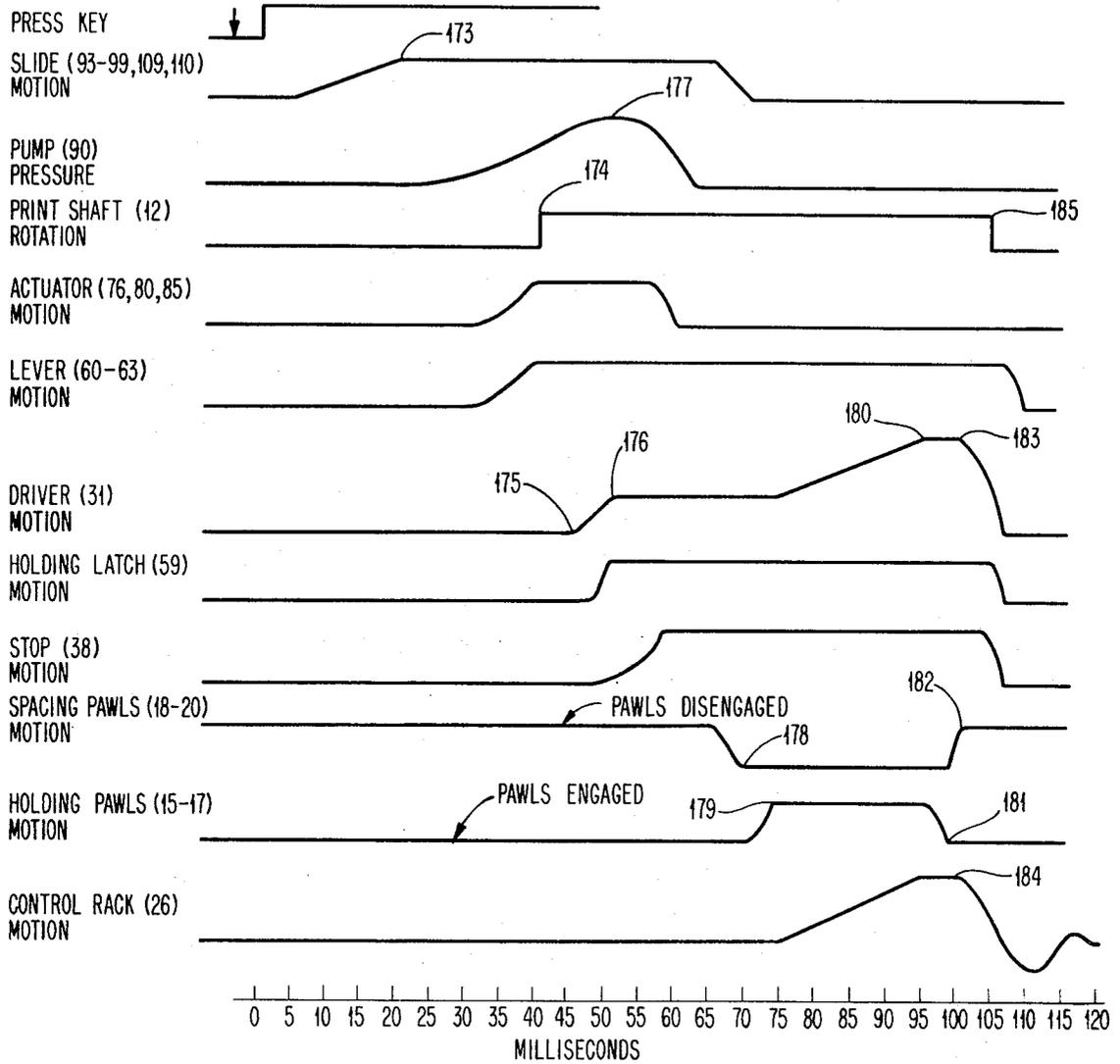


FIG. 7



## BI-DIRECTIONAL SPACING MECHANISM FOR A PRINTER INCLUDING A PROPORTIONAL SPACING PRINTER

One previously suggested spacing mechanism for advancing a single element printing head has employed a pair of parallel racks with one being stationary and the carrier for the single element printing head having pawls cooperating with each of the racks. During each print cycle, the movable rack is moved against the force of a spring to advance the printing head relative to the fixed platen. Thus, in this previously suggested spacing mechanism, the printing head is advanced the same amount during each print cycle. A pawl on the carrier for the printing head cooperates with the stationary rack to hold the printing head in the advanced position.

However, the spring acting on the movable rack to continuously urge it in the reverse direction prevents this previously suggested spacing mechanism from being employed to move the printing head in the reverse or backspace direction. Thus, the previously suggested spacing mechanism can only be employed to move the single element printing head in a forward direction. Similar mechanism has been employed for backspace only operation.

Furthermore, the previously suggested spacing mechanism must advance the single element printing head the same amount during each print cycle. Therefore, the previously suggested spacing mechanism is limited to advancing the single element printing head the same increment during each print cycle.

Since it is necessary for a typist to be able to backspace as well as advance the printing point, the previously suggested mechanism is not generally applicable to typing stations. The present invention satisfactorily overcomes the foregoing problem by employing a pair of substantially parallel racks to allow the printing position to be moved in either the forward or reverse direction.

The present invention utilizes a movable rack, which is capable of being moved in either direction, whereby the single element printing head, which defines the printing point, may be moved in a forward or reverse direction. The movable rack is not biased in either direction but is merely moved in either direction in response to movement of a connected input member.

The spacing mechanism of the present invention is particularly useful in a proportional spacing typewriter. In a proportional spacing typewriter, the widths of the type characters vary in accordance with the natural width of the characters. Thus, the space allotted to a type character having a small natural width is small in comparison with type characters having a large natural width. The various type characters are assigned arbitrary units of width in accordance with their natural widths.

The present invention, which enables a simplified spacing mechanism to be employed to obtain variable spacing in accordance with the width of the character in both the forward and reverse directions, is particularly useful with a single element printing head. In this manner, the single element printing head is advanced the desired amount for the typed character or is backspaced the width of the typed character. Accordingly, the spacing mechanism of the present invention allows a single element printing head to be em-

ployed with proportional spacing of its type characters during printing.

In the spacing mechanism of the present invention, the input member is driven the same amount irrespective of the width of the character that is to be typed. A bi-directional relief spring is employed between the input member and the movable or control rack to absorb any motion of the input member that does not produce movement of the movable rack because the movable rack is prevented from moving.

The amount of linear motion of the movable rack by the input member during each cycle of the print shaft is determined through positioning a control element relative to the movable rack to limit its movement by the input member. Thus, the control element regulates the movement of the movable rack so that the movable rack is moved the desired amount in accordance with the arbitrary units of width of the character being printed.

An object of this invention is to provide a printer having a spacing mechanism for driving a letter feeding part in opposite directions.

Another object of this invention is to provide a variable spacing mechanism for a printer, particularly one using a single element printing head.

A further object of this invention is to provide a printer having a letter feeding part movable selected variable increments in either the forward or reverse direction.

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

In the drawings:

FIG. 1A is an exploded perspective view of a portion of the bi-directional spacing mechanism of the present invention used with a typewriter having a single element printing head and taken from the rear of the typewriter.

FIG. 1B is an exploded perspective view of the remainder of the bi-directional spacing mechanism of the present invention.

FIG. 2 is a top plan view of a portion of the movable or control rack and showing the pawls, which cooperate therewith, removed therefrom.

FIG. 3 is a top plan view, similar to FIG. 2, but showing one of the pawls fully engaged with the movable or control rack.

FIG. 4 is a top plan view, similar to FIGS. 2 and 3, but showing all of the pawls engaged with the movable or control rack and locked in position.

FIG. 5 is an exploded perspective view of a portion of the spacing mechanism of FIG. 1B and showing in detail portions of the mechanism used in the tab operation.

FIG. 6 is a perspective view of a mechanism for selecting a character to be printed or other typewriter operation that is to occur.

FIG. 7 is a timing chart showing the relationship of various parts of the mechanism during a print cycle.

Referring to the drawings and particularly FIG. 1B, there is shown a single element printing head 10, which is mounted on a carrier 11 for both rotation and tilting to print a selected character on the head 10 in a

manner such as that more particularly shown and described in U.S. Pat. No. 2,919,002 to Palmer. The carrier 11 is supported on print shaft 12 for movement relative to a platen 14, which is fixed as more particularly shown and described in the aforesaid Palmer patent. Thus, the carrier 11 is a letter feeding part.

The carrier 11 has a first set of holding pawls 15, 16, and 17 and a second set of spacing pawls 18, 19, and 20 mounted thereon for movement therewith when the carrier 11 moves. The pawls 15-20 are pivotally mounted on a rod 21, which extends downwardly from a bracket 22 fixed to the carrier 11.

The pawls 15-17 cooperate with teeth 22' of an elongated holding rack 23, which is fixed to a portion 24 of the frame of the typewriter by suitable means such as screws 25. Thus, when at least one of the pawls 15-17 is in engagement with the teeth 22' of the holding rack 23, the carrier 11 is prevented from moving since the carrier 11 is coupled to the fixed rack 23 at this time.

The second set of pawls 18-20 cooperates with teeth 153 on an elongated control rack 26. The control rack 26 is mounted in spaced relation to the rack 23 and is disposed substantially parallel thereto. The rack 26 is held in slightly spaced relation to the rack 23 by thin spacers 27, which are washers and surround the screws 25 secured to the rack 23 and extending through longitudinal slots 29 in the control rack 26.

The longitudinal slots 29 enable the control rack 26 to move linearly relative to the fixed rack 23 in the same directions as the carrier 11 moves. Accordingly, when the pawls 18-20 are engaging the teeth 153 of the control rack 26, the carrier 11 is coupled thereto and can be advanced therewith when the holding pawls 15-17 are uncoupled from the teeth 22' of the holding rack 23.

The direction of movement of the carrier 11 depends on the direction of movement of the control rack 26. Likewise, the amount of movement of the carrier 11 depends on the amount of movement of the control rack 26.

The control rack 26 is moved in the forward (This is to the left in FIGS. 1A and 1B.) direction through a notch 30 (see FIG. 1A) on a driver 31 receiving a lug 32 on a bellcrank 33, which is pivotally mounted on a shoulder screw 34 fixed to a portion of the frame of the typewriter, whereby the driver 31 engages the lug 32 to move the bellcrank 33. The driver 31 is continuously biased counterclockwise against the screw 34, which extends through a slot 33' in the driver 31, by a spring 34', which is secured to the driver 31 and to a portion of the frame of the typewriter, to present the notch 30 on the driver 31 in alignment with the lug 32 on the bellcrank 33. The movement of the bellcrank 33 is transmitted through a spring 35 to a bellcrank 36, which also is pivotally mounted on the shoulder screw 34.

The counterclockwise pivoting of the bellcrank 33 causes counterclockwise pivoting of the bellcrank 36 to cause the bellcrank 36 to engage an upstanding stud 37 on the control rack 26. This moves the control rack 26 in the forward direction. Movement of the control rack 26 in the reverse or backspace direction, as hereinafter described, involves transmittal of clockwise motion from the bellcrank 36 through the spring 35 to the bellcrank 33.

The amount of linear movement of the control rack 26 is determined by the position of a stop or control element 38, which is mounted for pivotal movement about a shaft 57 fixed to the frame of the typewriter and has a plurality of stepped surfaces 39 thereon for cooperation with a lug 40 on the control rack 26. The lug 40 is adjustably secured to the bottom surface of the control rack 26. The movement of the control rack 26 is decreased as the stop 38 is moved downwardly since the stepped surfaces 39 protrude further from the stop 38 in an upward progression.

Since the driver 31 is driven the same constant stroke during each cycle of operation, the spring 35 absorbs any of the movement of the driver 31 that is not transmitted to the control rack 26. Thus, when the control rack 26 has the lug 40 abutting against one of the stepped surfaces 39 of the stop 38, further movement of the control rack 26 is prevented so that the bellcrank 36 can no longer pivot counterclockwise.

However, the bellcrank 33 continues to pivot until the driver 31 completes its constant stroke. The spring 35 extends to absorb this energy and allow the bellcrank 33 to complete its counterclockwise pivoting.

When the control rack 26 is disconnected from the pawls 18-20 and the driver 31 moves in the rearward direction so as to cease to exert a force on the lug 32 of the bellcrank 33, the spring 35 urges the bellcrank 33 clockwise so that it engages an upstanding stud 46 on the control rack 26. Because the stud 46 is closer to the pivot axis of the bellcranks 33 and 36 than the stud 37, which has the bellcrank 36 engaging thereagainst, a greater force is transmitted to the control rack 26 by the bellcrank 33 acting on the stud 46. Accordingly, the control rack 26 is returned to the home position in which both of the bellcranks 33 and 36 engage both of the studs 37 and 46. In this position, the axes of the studs 37 and 46 are on a straight line which is perpendicular to the longitudinal axis of the control rack 26 and includes the pivot axis of the bellcranks 33 and 36.

When the control rack 26 is to be moved in the reverse or backspace direction (This is to the right in FIGS. 1A and 1B.), a pivotally mounted backspace lever 41 is pivoted through supplying a pulse of pressurized gas such as air, for example, to a bellows actuator 42, which is mounted on the frame of the typewriter and contacts the lever 41, by a hose or conduit 43. The counterclockwise pivoting of the backspace lever 41 about a pivot rod 43' shifts the driver 31 against the force of the spring 34' so that the notch 30 is no longer aligned with the lug 32 when the driver 31 is moved forwardly. Instead, a notch 44 on the driver 31 is now aligned with a lug 45 on the bellcrank 36. Because of the force of the spring 34', the notch 44 and the lug 45 are not in alignment except when the backspace lever 41 is activated by the bellows actuator 42.

It should be understood that the width of the slot 33' in the driver 31 through which the screw 34 extends is designed so that the desired alignment between the notch 44 and the lug 45 occurs depending on the position of the backspace lever 41. That is, when the backspace lever 41 is not activated by the bellows actuator 42, the side of the slot 33' in the driver 31 closest to the notch 44 bears against the screw 34. When the backspace lever 41 is activated, the amount of shifting of the driver 31 by the backspace lever 41 until the side

of the slot 33' in the driver 31 closest to the notch 30 bears against the screw 34 is equal to the distance required to align the notch 44 with the lug 45.

Accordingly, with the notch 44 aligned with the lug 45, the forward motion of the driver 31 causes clockwise pivoting of the bellcrank 36 about the shoulder screw 34. This motion is transmitted through the spring 35 to the bellcrank 33 to cause the bellcrank 33 to pivot clockwise and engage the upstanding stud 37 on the control rack 26.

When this occurs, the control rack 26 is moved in the reverse or backspace direction. The control rack 26 continues to move in the backspace direction until a lug 47, which is adjustably secured to the lower surface of the control rack 26 and on the opposite side of a slot 48 in the control rack 26 from the lug 40, engages one of a plurality of stepped surfaces 49, which are on the opposite side of the stop 38 from the set of stepped surfaces 39. The amount of linear movement of the control rack 26 depends upon the vertical position of the stop or control element 38, which extends through the slot 48, in the same manner as previously described for forward movement of the control rack 26.

When the lug 47 on the control rack 26 engages one of the stepped surfaces 49 on the stop 38, the bellcrank 33 can no longer pivot clockwise because the stud 37 is held. However, the driver 31 continues to move forwardly until it completes its constant stroke so that the bellcrank 36 continues to pivot clockwise. This motion is absorbed by the spring 35 extending.

When the control rack 26 is disconnected from the pawls 18-20 and the driver 31 moves in the rearward direction so as to cease to exert a force on the lug 45 of the bellcrank 36, the spring 35 urges the bellcrank 36 counterclockwise so that it engages the upstanding stud 46. Because the stud 46 is closer to the pivot axis of the bellcranks 33 and 36 than the stud 37, which has the bellcrank 33 engaging thereagainst, a greater force is transmitted to the control rack 26 by the bellcrank 36 acting on the stud 46. Accordingly, the control rack 26 is returned to the home position in which both of the bellcranks 33 and 36 engage both of the studs 37 and 46. In this position, the axes of the studs 37 and 46 are on a straight line which is perpendicular to the longitudinal axis of the control rack 26 and includes the pivot axis of the bellcranks 33 and 36.

The driver 31 is driven from the print shaft 12, which has a cam 51 mounted thereon for rotation therewith. The cam 51 cooperates with a roller 52 on a pivotally mounted follower 53, which is connected to the driver 31 through a loose fit with a link 54 by the link 54 having a pin 54a disposed in an enlarged hole 54b in the follower 53; the link 54 is welded to the driver 31. The print shaft 12 is driven counterclockwise during each cycle of operation irrespective of whether there is a character printed.

However, during backspacing, there is no printing by the single element printing head 10. This is accomplished through a suitable control mechanism preventing the printing head 10 from being actuated to print a character.

As previously mentioned, the amount of linear movement of the control rack 26 in either direction depends upon which of the surfaces 39 or 49 is disposed for engagement with the lug 40 or 47, respectively, of the

control rack 26. The vertical position of the stop 38 within the slot 48 determines the number of units that the control rack 26 is moved. While the number of units may vary as desired, the present invention is shown and described with the control rack 26 being movable one, four, five, six, seven, eight, or nine units depending upon the position of the stop or control element 38.

The maximum movement (nine units) of the control rack 26 is when the stop 38 has the lowermost of the surfaces 39 or 49 disposed for engagement by the lug 40 or 47, respectively. This is the rest or home position of the stop 38. The minimum amount of movement (one unit) of the control rack 26 occurs when the stop 38 is in its lowermost position.

Each forward movement of the driver 31 causes a downwardly depending flange 55 thereon to move therewith. When the driver 31 is in its home position, the flange 55 engages a lug 56 on the stop 38 to retain the stop 38 in the home position in which the lowermost surfaces of the surfaces 39 and 49 are disposed for cooperation with the lugs 40 and 47, respectively, on the control rack 26.

The lug 56 on the pivotally mounted stop 38 is continuously urged into engagement with the flange 55 of the driver 31 by a spring 58. Accordingly, the spring 58 causes the lug 56 on the stop 38 to follow the forward movement of the flange 55 on the driver 31 until clockwise movement of the stop 38 is stopped.

A holding latch 59, which also is pivotally mounted on the shaft 57, also follows the forward movement of the driver 31 through having a lug 59a thereon urged into engagement with the flange 55 of the driver 31 by a spring 59b, which continuously urges the holding latch 59 clockwise about the shaft 57. Thus, when the driver 31 is in its home position, the flange 55 of the driver 31 retains the holding latch 59 in its home position against the force of the spring 59b.

The amount of clockwise pivoting of the stop 38 by the spring 58 is determined by the positions of a resiliently biased actuating lever 60, an intermediately resiliently biased actuating lever 61, a resiliently biased actuating lever 62, a resiliently biased actuating lever 63, and a bar 64. The levers 60 and 62 and the intermediate lever 61 are pivotally mounted on a shaft 65, which is fixed to a portion of the frame of the typewriter, while the lever 63 is pivotally mounted on a shaft 66, which is fixed to a portion of the frame of the typewriter. The bar 64 is slidably mounted on the stop 38 through screws 67, which are secured to the stop 38, extending through elongated slots 68 in the bar 64.

The actuating lever 60 has a finger 69 at one end thereof cooperating with a finger 70 on the bar 64. The intermediate actuating lever 61 has a finger 71 at one end thereof cooperating with a second finger 72 on the bar 64. The actuating lever 62 has a finger 73 at one end thereof cooperating with a third finger 74 on the bar 64.

When the bar 64, the lever 60, the intermediate lever 61, and the lever 62 are disposed so that the fingers 69, 71, and 73, respectively, are aligned with the fingers 70, 72, and 74, respectively, as shown in FIG. 1A, the finger 71 engages the finger 72 to prevent movement of the stop 38 by the spring 58 when the driver 31 is moved forward. Thus, the stop 38 is disposed with the

lowermost of the surfaces 39 and 49 in position for cooperation with the lugs 40 and 47, respectively, on the control rack 26. This position enables the maximum movement (nine units) of the control rack 26 in either the forward or reverse direction depending upon whether it is desired for the printing head 10 to be moved in the forward or reverse direction relative to the paper on which there are printed characters.

When a pulse of pressurized gas such as air, for example, is supplied through a hose or conduit 75 to a bellows actuator 76, which is mounted on the frame of the typewriter and contacts the latch 63, the bellows actuator 76 moves the actuating lever 63 to pivot it clockwise about the shaft 66. When this occurs, a finger 77 on the lever 63 cooperates with a finger 78 on the bar 64 to shift the bar 64 to the right.

When the bar 64 shifts to the right, the fingers 70, 72, and 74 are moved away from alignment with the fingers 69, 71, and 73, respectively, of the levers 60, 61, and 62, respectively. This exposes a lower portion 78' of the stop 38 through slots in the bar 64. The portion 78' is further away from the fingers 69, 71, and 73 in the forward direction of the driver 31.

As a result, when the driver 31 is moved forward, the spring 58 produces a slight pivoting of the stop 38 because of the lower portion 78' of the stop 38 that is cooperating with the finger 71 of the lever 61. This amount of movement of the stop 38 presents the next to bottom surfaces of the stepped surfaces 39 and 49 for cooperation with the lugs 40 and 47, respectively, on the control rack 26. This allows the control rack 26 to move eight units in either the forward or reverse direction.

Whenever a pulse of pressurized gas such as air, for example, is supplied through a hose or conduit 79 to a bellows actuator 80, which is mounted on the frame of the typewriter and contacts a portion 81 of the lever 60, the lever 60 is pivoted clockwise about the shaft 65 to dispose the finger 69 of the lever 60 so that it cannot be engaged by the finger 70 of the bar 64. Because the intermediate lever 61 has an arm 82 disposed adjacent the portion 81 of the lever 60, the clockwise movement of the lever 60 also causes clockwise pivoting of the intermediate lever 61 about the shaft 65 to remove the finger 71 of the intermediate lever 61 from a position in which the finger 71 can be engaged by the finger 72 of the bar 64.

Accordingly, when only the bellows actuator 80 has the pulse of pressurized gas supplied thereto, the stop 38 is pivoted clockwise to a position in which the control rack 26 may be moved seven units in either direction. The clockwise pivoting of the stop 38 by the spring 58 is stopped by the finger 74 of the bar 64 engaging the finger 73 of the lever 62. This permits sufficient clockwise pivoting, as previously mentioned, of the stop or control element 38 so that the control rack 26 is moved seven units.

As previously set forth, the forward movement of the driver 31 also results in the holding latch 59 pivoting clockwise due to the force of the spring 59b. When the actuating lever 60 has been pivoted clockwise through the bellows actuator 80 being activated, the holding latch 59 has a finger 83 on an arm 83a thereof engage a finger 83b on the lever 60 to retain the lever 60 in the position in which the finger 69 is removed from the

swinging path of the finger 70 of the bar 64 after the pulse of pressurized gas to the bellows actuator 80 has ceased.

Thus, this arrangement of the holding latch 59 insures that the lever 60 is not returned to the position of FIG. 1A and also insures that the lever 62 is not activated until the driver 31 has returned to the position of FIG. 1A. The driver 31 returns to the position of FIG. 1A at the end of the cycle of operation.

When in its home position in which the flange 55 of the driver 31 is engaging the lug 59a, the finger 83 of the holding latch 59 is normally disposed beneath and slightly forward of the finger 83b on the lever 60. Thus, if the lever 60 has not been activated during a cycle of operation, the finger 83 passes in front of the finger 83b. The clockwise pivoting of the holding latch 59 by the spring 59b is stopped when a protrusion 83c on the arm 83a of the holding latch 59 engages the lower surface of the finger 83b when the lever 60 has not been activated. If the lever 60 is activated, the clockwise pivoting of the holding latch 59 is stopped by the upper surface of the arm 83a engaging the lower surface of the finger 83b of the lever 60 since the finger 83 of the holding latch 59 is now to the rear of the finger 83b of the lever 60.

If it should be desired to move the control rack 26 six units, then the bellows actuator 80 would again be activated along with the bellows actuator 76. This would shift the bar 64 to the right so that the lower portion 78' of the stop 38 would be disposed for cooperation with the finger 73 of the lever 62. This would enable a slight additional clockwise pivoting of the stop 38 before the finger 73 of the lever 62 engages the lower portion 78' of the stop 38 to stop pivoting of the stop 38.

Whenever a pulse of pressurized gas such as air, for example, is supplied through a hose or conduit 84 to a bellows actuator 85, which is mounted on the frame of the typewriter and contacts a portion 86 of the lever 62, the lever 62 is pivoted clockwise about the axis of the shaft 65 to remove the finger 73 from a position in which it can engage the finger 74 of the bar 64. As the lever 62 pivots clockwise, the portion 86 engages an arm 87 of the intermediate lever 61 to also cause the finger 71 of the intermediate lever 61 to be removed from the position in which the finger 71 would engage the finger 72 of the bar 64.

Accordingly, when the driver 31 is driven forward, the stop 38 pivots clockwise until the finger 70 of the bar 64 engages the finger 69 of the lever 60. This results in the stop 38 being disposed so that the control rack 26 can be moved five units in either direction.

If four units of movement of the control rack 26 is desired, then the pulses of pressurized gas are supplied to both the bellows actuator 85 and the bellows actuator 76. This not only pivots the lever 62 and the intermediate lever 61 but also shifts the bar 64. As a result, when the stop 38 pivots clockwise, the finger 69 of the lever 60 engages the lower portion 78' of the stop 38 rather than the finger 70 of the bar 64 whereby a slight additional pivoting of the stop 38 occurs.

Whenever the lever 62 is pivoted clockwise through the bellows actuator 85 receiving the pulse of pressurized gas, the finger 83 of the holding latch 59 engages a finger 87' of the lever 62 when the driver 31 is advanced in a forward direction. This holds the lever

62 in this position when the pulse of gas is stopped. With the lever 60 inactivated, the clockwise pivoting of the holding latch 59 is stopped by the protrusion 83c of the arm 83a engaging the bottom surface of the finger 83b.

Likewise, whenever the bellows actuator 76 shifts the bar 64, a finger 88 of the holding latch 59 moves against one side of the finger 77 of the lever 63 to hold it in the position to which it has been moved by the bellows actuator 76 when the holding latch 59 pivots clockwise. This is necessary because of the short pulse period in which the pressurized gas is supplied. It should be understood that the finger 88 of the holding latch 59 moves against the other side of the finger 77 of the lever 63 to prevent any accidental movement of the lever 63 when the bar 64 is not shifted.

If it is desired for the control rack 26 to move only one unit (As presently contemplated, this would only be used for backspacing.), then all of the bellows actuators 76, 80, and 85 must be activated. When this occurs, all of the fingers 69, 71, and 73 of the actuating levers 60, 61, and 62, respectively, are removed from the position in which they would engage the fingers 70, 72, and 74, respectively, of the bar 64. Likewise, the bar 64 is shifted.

As a result, a lug 89 of the intermediate lever 61 will be engaged by the lower portion 78' of the stop 38. This allows the maximum pivoting of the stop 38 so that the uppermost surfaces of the stepped surfaces 39 and 49 are disposed for cooperation with the lugs 40 and 47, respectively, of the control rack 26.

The selection of which of the bellows actuators 76, 80, and 85 is energized depends upon the character key or other functional operation key of the typewriter that is selected. Thus, the maximum movement of the control rack 26 occurs when none of the actuators 76, 80, and 85 is activated. Likewise, the minimum movement of the control rack 26 occurs when all of the actuators 76, 80, and 85 are activated. Therefore, depending on the particular character or other functional operation selected, the pressurized gas pulses are selectively supplied to none, one, two, or all of the actuators 76, 80, and 85.

The pulses of pressurized gas are supplied to the bellows actuators 42, 76, 80, and 85 from a pump 90 (see FIG. 6), which is connected by a conduit or hose 91 to a pneumatic logic device 92. The pneumatic logic device 92 may be constructed generally like the logic device shown and described in U.S. Pat. Nos. 1,089,689 to Burboa and 2,115,991 to Kleinschmidt.

The pneumatic logic device 92 has selection slides 93, 94, 95, 96, 97, 98, and 99 slidably supported therein and disposed in either a home position or a displaced position depending upon the position of a cooperating encoding bail. Thus, encoding bails 100, 101, 102, 103, 104, 105, and 106 cooperate with the selection slides 93, 94, 95, 96, 97, 98, and 99, respectively.

The encoding bails 100-106 are selectively actuated by various interposers 107 of a keyboard, which is an output control device, of the type shown and described in U.S. Pat. No. 3,086,635 to Palmer, for example. Accordingly, when one of the interposers 107 is positioned by depression of a keylever (not shown) so as to be actuated by a filter shaft 108 rotating counter-

clockwise in the manner more particularly shown and described in the aforesaid Palmer U.S. Pat. No. 3,086,635, one or more of the encoding bails 100-106 is moved to displace the cooperating selection slides 93-99 therewith. This displaces each of the selection slides 93-99, which has its cooperating encoding bail of the bails 100-106 moved by the interposer 107, from its home position to a displaced position. The other of the selection slides 93-99 remain in their home positions since their encoding bails of the bails 100-106 were not activated by the movement of the interposer 107.

The logic device 92 also includes a code slide 109 and a shift slide 110. Thus, each of the code slide 109 and the shift slide 110 can be in either a home position or a displaced position. Each of the selection slides 93-99, the code slide 109, and the shift slide 110 is continuously urged to its home position by a separate cooperating spring 110'.

The code slide 109 is moved to its displaced position only when a code key 111 is depressed to pivot a rod 112 clockwise. This moves a finger 113 on a code actuate arm 114, which is fixed to the rod 112, downwardly against a code interposer 115. When the finger 113 moves the code interposer 115 downwardly, the force of a spring 116, which urges the code interposer 115 upwardly, is overcome whereby the code interposer 115 is disposed for movement by the filter shaft 108. Thus, when the filter shaft 108 rotates counterclockwise, a finger 117 on the code interposer 115 engages a tab 118 on the code slide 109 to move the code slide 109 from its home position to its displaced position.

Whenever a shift key (not shown) is activated, a shift interposer (not shown) is moved downwardly against the force of its spring, which urges the shift interposer upwardly, to position the shift interposer for movement by the filter shaft 108 during its counterclockwise rotation. Thus, when the filter shaft 108 rotates counterclockwise, the shift slide 110 is moved from its home position to its displaced position by a finger on the shift interposer engaging a tab 119 on the shift slide 110.

Each of the selection slides 93-99, the code slide 109, and the shift slide 110 has openings or holes therein at its home position or its displaced position or both positions to provide various potential flow paths or channels from an input manifold 120 of the logic device 92 to an output manifold 120' of the logic device 92 and then to the hose or conduit 43 for the bellows actuator 42, the hose or conduit 75 for the bellows actuator 76, the hose or conduit 79 for the bellows actuator 80, and the hose or conduit 84 for the bellows actuator 85. Additionally, there is a plurality of other hoses or conduits 121 extending from the pneumatic logic device 92 to various portions of the typewriter for producing various movements. There are a total of approximately twenty hoses or conduits including the hoses or conduits 43, 75, 79, and 84.

Whenever the filter shaft 108 is rotated counterclockwise in the manner more particularly shown and described in the aforesaid Palmer U.S. Pat. No. 3,086,035, a clamping cam 122 rotates counterclockwise therewith to pivot a follower 123 counterclockwise about a fixed pivot pin 124. The counterclockwise movement of the cam follower 123 pulls a

spring 125, which has one end connected to a rod 126 on the follower 123 and its other end connected to a rod 127 on an arm 128. This movement of the spring 125 pivots the arm 128 counterclockwise about a pivot pin 129 to move a portion of the arm 128 into engagement with a bar 130, which is fixed to the input manifold 120 of the pneumatic logic device 92. This clamps the displaced slides of the slides 93-99, 109, and 110 of the logic device 92 in their displaced positions and seals the logic device 92 against undersired gas losses. Since the output manifold 120' is fixed and the input manifold 120 is movable towards the output manifold 120' by the arm 128, movement of the input manifold 120 towards the output manifold 120' clamps the displaced slides of the slides 93-99, 109, and 110 therebetween in their displaced positions.

When the follower 123 returns to the position of FIG. 6 due to the configuration of the cam 122, the arm 128 is returned to the position of FIG. 6 by a connecting link 131, which has one end fixed to the rod 126 on the follower 123 and its other end in surrounding relation to the rod 127 on the arm 128. This end of the link 131 is bifurcated so as to allow relative movement with respect to the rod 127 when the spring 125 is effective.

During each cycle of the filter shaft 108, the pump 90 is powered by an eccentric cam 132, which is fixed to a shaft 133 of a gear train 134 for rotation therewith. The gear train 134 is powered from the filter shaft 108 through having its gear 135 secured to the filter shaft

108. Accordingly, the pressurized gas is supplied from the pump 90 to the pneumatic logic device 92 at the correct time during the cycle of operation to supply pulses of pressurized gas to any of the desired actuators 42, 76, 80, and 85 through the various conduits 43, 75, 79, and 84 due to the positions of the selection slides 93-99, the code slide 109, and the shift slide 110.

As previously mentioned, each of the selection slides 93-99, the code slide 109, and the shift slide 110 has openings or holes therein in its home position or its displaced position or both positions to provide various potential flow paths or channels through the logic device 92 from the pump 90. The table, which is set forth hereinbelow, indicates whether each of the slides 93-99, 109, and 110 has an opening for a particular channel, which is represented by a horizontal row, at its home position, its displaced position, or both its home and displaced positions.

When the table shows "1" for a particular slide for a particular channel, this indicates that the slide has an opening or hole only when the slide is at its displaced position. When the table shows a "0" for a particular slide for a particular channel, this represents that the slide has a hole or opening only when the slide is in its home position. If there is a "-" for a slide in a particular channel, this indicates the presence of holes or openings in this slide at both the home and displaced positions for this particular channel.

The table is as follows:

Channel	SLIDES										Actuators
	93	94	95	96	97	98	99	110	109		
A-1	1	-	-	-	-	-	-	-	-	-	Selection
A-2	-	1	-	-	-	-	-	-	-	-	Selection
A-3	-	-	1	-	-	-	-	-	-	-	Selection
A-4	-	-	-	1	-	-	-	-	-	-	Selection
A-5	-	-	-	-	1	-	-	-	-	-	Selection
A-6	-	-	-	-	-	1	-	-	-	-	Selection
A-7	-	-	-	-	-	-	1	-	-	-	Cycle clutch
A-8	0	0	0	1	0	0	0	-	-	-	Lower case
A-9	0	0	0	1	0	1	0	-	-	-	Upper case
A-10	1	1	0	1	0	-	0	-	-	-	Index
A-11	1	1	0	1	0	1	0	-	-	-	Carrier return
A-12	0	1	0	1	0	1	0	-	-	-	Tab (Actuator 207)
A-13	-	1	0	1	0	1	0	-	-	-	Homing (Actuator 192)
A-14	0	1	0	1	0	0	1	-	-	-	Backspace
A-15	-	-	-	-	-	-	-	-	-	1	(Actuator 42)
B-1	-	-	-	-	-	-	-	1	-	1	
B-2	-	-	-	-	0	1	1	1	1	-	
B-3	-	-	-	1	1	0	1	1	1	-	
B-4	1	0	1	-	1	1	1	1	1	-	
B-5	0	0	0	0	1	0	1	-	-	-	
B-6	-	1	1	0	1	1	1	1	1	-	
B-7	1	1	1	1	-	0	1	-	-	-	
B-8	0	1	1	1	-	-	1	1	1	-	
B-9	-	0	1	0	0	0	1	-	-	-	First velocity control
B-10	1	0	0	0	-	0	1	1	1	-	
B-11	0	0	-	0	0	1	1	0	-	-	
B-12	-	0	-	0	1	1	1	0	-	-	
B-13	0	1	1	-	-	1	1	0	-	-	
B-14	0	0	1	1	1	1	1	0	-	-	
B-15	1	0	1	1	0	1	1	0	-	-	
B-16	1	0	0	1	1	1	1	-	-	-	
B-17	1	0	0	0	0	-	1	0	-	-	
B-18	0	0	0	1	1	-	1	-	-	1	
C-1	-	-	-	-	-	-	-	1	-	1	
C-2	0	0	0	0	0	0	1	-	-	-	Second velocity control
C-3	-	0	1	1	0	0	1	-	-	-	
C-4	0	1	1	0	1	0	1	-	-	-	
C-5	1	0	1	0	1	0	1	0	-	-	
C-6	0	0	0	1	1	-	1	-	-	-	
D-1	-	-	-	-	1	1	1	-	-	-	
D-2	-	0	-	0	0	-	1	0	-	-	
D-3	-	1	1	0	1	0	1	-	-	-	
D-4	-	0	-	1	0	0	1	-	-	-	
D-5	0	1	1	0	0	-	1	0	-	-	
D-6	-	1	1	0	0	0	1	1	-	-	
D-7	1	0	0	0	1	0	1	-	-	-	
D-8	-	-	1	1	0	1	1	0	-	-	
D-9	1	0	-	1	1	0	1	0	-	-	Space control (Actuator 80)
D-10	0	-	1	1	1	0	1	0	-	-	
D-11	1	1	1	1	0	0	1	0	-	-	
D-12	0	0	0	1	0	1	1	-	-	-	
D-13	1	0	1	0	0	-	1	1	-	-	
D-14	0	0	0	0	0	0	1	1	-	-	
D-15	0	1	1	1	0	0	1	1	-	-	
D-16	1	0	0	1	0	1	1	1	-	-	
D-17	1	0	1	0	1	0	1	1	-	-	

Continued

Channel	SLIDES									Actuators
	93	94	95	96	97	98	99	110	190	
E-1	0	0	0	1	1	0	1	-	-	Space control (Actuator 85)
E-2	0	0	0	1	0	1	1	-	-	
E-3	0	0	1	0	1	0	1	-	-	
E-4	0	1	1	1	0	0	1	0	-	
E-5	1	1	1	0	0	-	1	0	-	
E-6	1	0	1	0	1	0	1	0	-	
E-7	1	0	0	1	0	1	1	0	-	
F-1	0	-	-	1	1	-	1	-	-	Space control (Actuator 76)
F-2	1	0	-	1	1	-	1	-	-	
F-3	-	-	-	0	1	-	1	0	-	
F-4	0	0	1	1	0	-	1	-	-	
F-5	-	-	1	0	1	0	1	1	-	
F-6	0	-	-	0	0	-	1	1	-	
F-7	1	1	1	0	0	-	1	-	-	
F-8	1	0	-	1	0	0	1	-	-	
F-9	-	-	1	1	0	1	1	1	-	
F-10	1	1	1	1	1	1	1	-	-	
F-11	-	0	0	0	0	0	1	-	-	
F-12	-	0	-	0	1	1	1	1	-	
F-13	0	1	1	-	0	0	1	0	-	
F-14	1	0	1	0	0	1	1	0	-	
F-15	1	0	0	1	0	1	1	0	-	
F-16	1	0	0	0	0	1	1	1	-	
F-17	0	1	1	0	1	1	1	1	-	
F-18	1	1	1	1	0	0	1	1	-	
F-19	0	0	0	1	0	1	1	-	-	

Accordingly, from the table, it can be ascertained that any particular flow path or channel is satisfied or defined by certain positions of the selection slides 93-99, the code slide 109, and the shift slide 110. For example, a pulse of pressurized gas can flow through channel A-15 only when the code slide 109 is at its displaced position with the remainder of the slides, namely, the slides 93-99 and 110 in either position. This occurs only when the code key 111 is depressed during a cycle of operation to produce a character backspace.

The hose or conduit 75 receives a pulse of pressurized gas when any of channels F-1 to F-19 is satisfied. When this occurs, the space control actuator 76 receives the pulse of pressurized gas to pivot the lever 63. For example, a pulse of pressurized gas is supplied to the actuator 76 through the channel F-1 when the selection slide 93 is in its home position, the selection slides 96, 97, and 99 are at their displaced positions, and the selection slides 94, 95, and 98, the code slide 109, and the shift slide 110 are either at their displaced or home positions.

Similarly, the hose or conduit 79 receives a pulse of pressurized gas from the pump 90 through the pneumatic logic device 92 whenever any of channels D-1 to D-17 is satisfied. For example, the space control actuator 80 is activated through the channel D-1 when the selection slides 97-99 are in their displaced positions while the selection slides 93-96, the code slide 109, and the shift slide 110 are in either their displaced or home positions. When this occurs, the channel D-1 supplies the pulse of pressurized gas to the hose or conduit 79 for activating the actuator 80 whereby the lever 60 is pivoted.

When any of channels E-1 to E-7 is satisfied, the hose or conduit 84 receives a pulse of pressurized gas from the pump 90 through the pneumatic logic device 92. When this occurs, the lever 62 is pivoted by the space control actuator 85.

Channels A-1 to A-6 are employed to directly control a selection mechanism like that disclosed in the aforesaid Palmer U.S. Pat. No. 2,919,002, to permutatively define the particular character selected for print-

ing through the selection actuators. Channels A-7 to A-15 are employed to produce various other function operations of the typewriter by activating certain actuators as indicated in the table.

Any of channels B-1 to B-18 is utilized to control a first actuator for controlling velocity. Any of channels C-1 to C-6 is employed to control a second velocity actuator. These two velocity control actuators, which are employed to select the desired velocity, may be of the type more particularly shown and described on page 1032 of the December 1969 issue (Vol. 12, No. 7) of IBM Technical Disclosure Bulletin. During backspacing, these actuators select a non-print operation in the manner taught in U.S. Pat. No. 3,382,963 4c Cralle, Jr. et al. to prevent the printing head 10 from printing. In character backspacing, the velocity actuators are actuated by the channels B-1 and C-1 being satisfied.

As previously mentioned, the pawls 18-20 must be coupled to the control rack 26 and the holding pawls 15-17 uncoupled from the holding rack 23 when the printing head 10 is to be moved relative to the platen 14 to position the printing head 10. The pawls 15-17 are returned into engagement with the rack 23 and the pawls 18-20 are removed from the control rack 26, which positions the printing head 10, after completion of printing by the printing head 10 and before the completion of the cycle of operation.

The movements of the pawls 15-17 relative to the holding rack 23 and the pawls 18-20 relative to the control rack 26 are controlled by a phase cam 140 (see FIG. 1B), which is mounted on a sleeve 139 for rotation therewith. The sleeve 139, which is secured to the carrier 11 for movement therewith, is keyed to the print shaft 12 for rotation therewith while being moved axially relative to the print shaft 12 with the carrier 11. The print shaft 12 is activated by a cycle clutch during each cycle of operation of the typewriter in a manner such as shown and described in the aforesaid Palmer Pat. No. 2,919,002.

The phase cam 140 cooperates with a roller 141 on a follower 142, which is pivotally mounted on the carrier 11 and is connected to a resiliently biased phasing link 143. A spring 144, which is connected to the bracket

22, continuously urges the phasing link 143 in a rearward direction.

As the phasing link 143 is moved forward by the counterclockwise rotation of the phase cam 140 pivoting the follower 142 clockwise, a retaining lug 145 (see FIGS. 2-4) on an arm 146 of the phasing link 143 is withdrawn from engagement with the pawls 18-20. The lug 145 is disposed within notches 147, 148, and 149 of the pawls 18, 19, and 20, respectively. The pawls 18, 19, and 20 are urged into engagement with the lug 145 by springs 150, 151, and 152, respectively. The springs 150-152 are secured to their respective pawls 18-20 and to the bracket 22.

Accordingly, as the phasing link 143 moves forward (downwardly as viewed in FIGS. 2-4 and in the direction of the arrow), the pawls 18-20 are pivoted about the rod 21 by the springs 150-152 to follow the lug 145 as the phasing link 143 moves forward until one of the three pawls 18-20 enters between two adjacent teeth 153 of the control rack 26.

As shown in FIG. 3, the pawl 18 has its two teeth 154 enter fully between two of the adjacent teeth 153 of the control rack 26. The pawl 19 has its two teeth 155 disposed a half of tooth depth within the teeth 153 while the pawl 20 has its teeth 156 resting on top of one of the teeth 153 of the control rack 26.

Any of the three pawls 18-20 can have its teeth 154-156, respectively, enter between two of the teeth 153 of the control rack 26 or receive one of the teeth 153 of the control rack 26. This depends upon the location of the control rack 26 at the time that the pawls 18-20 move into engagement with the control rack 26 through forward movement of the phasing link 143. Thus, the entrance of the teeth 154 of the pawl 18 between the teeth 153 of the control rack 26, as shown in FIG. 3, is only one of six different possible arrangements.

After the phasing link 143 has reached the position of FIG. 3, continued forward movement of the phasing link 143 due to counterclockwise rotation of the phasing cam 140 causes a finger 157 on the phasing link 143 to engage a surface 158 of a bellcrank 159 to pivot the bellcrank 159 counterclockwise about the rod 21. When this occurs, a locking lever 160 is pivoted clockwise about a pin 161, which extends downwardly from the bracket 22 and extends through a slot 163 in the locking lever 160.

The clockwise pivoting of the locking lever 160 is produced through cooperation between a pin 164 on the locking lever 160 and an elongated slot 165 in the bellcrank 159. This pivots the locking lever 160 clockwise against the force of a spring 166, which is continuously urging the locking lever 160 counterclockwise by having one end secured to ear 166' of the locking lever 160 and the other end attached to the bracket 22, so that a surface 167, which is adapted to engage an inclined surface 167' on each of the pawls 18-20, thereon drives the pawls 19 and 20, which do not have their teeth 155 and 156, respectively, fully between the teeth 153 of the control rack 26. After the surface 167 of the locking lever 160 has driven the teeth 155 and 156 of the pawls 19 and 20, respectively, between two of the teeth 153 of the control rack 26 through engaging the surface 167' on each of the pawls 19 and 20, a surface 168 of the locking lever 160 cooperates with a surface 168' on each of the pawls

18-20 to retain them in engagement with the control rack 26. Thus, a positive coupling is provided between the control rack 26 and the pawls 18-20 by the surface 168 of the locking lever 160 engaging the surface 168' on each of the pawls 18-20.

It should be understood that the surface 167 of the locking lever 160 cooperates with each of the pawls 18-20 and drives the two of the pawls 18-20, which are not fully inserted between two of the adjacent teeth 153 of the control rack 26, into this position. Thus, the particular two pawls of the pawls 18-20 which are not fully inserted between the two of the teeth 153 of the control rack 26 depend on the position of the control rack 26 as previously mentioned.

As the phasing link 143 continues to move forward due to clockwise pivoting of the follower 142, the continued counterclockwise pivoting of the bellcrank 159 by the forward movement of the phasing link 143 causes its arm 169 (see FIG. 1B) to engage a projecting portion 170 on each of the pawls 15-17 to cause pivoting thereof about the rod 21 and against the force of a spring 171 for each of the pawls 15-17. Each of the springs 171 has one end attached to the bracket 22 while its other end is secured to one of the pawls 15-17.

This withdraws the pawls 15-17 from engagement with the holding rack 23. Accordingly, when this occurs, the control rack 26 can be moved due to movement of the driver 31 as previously mentioned.

After completion of movement of the control rack 26 to position the printing head 10 at its new printing position, the pawls 15-17 must again be coupled with the holding rack 23 to hold the printing head 10 in this new position, and the pawls 18-20 uncoupled from the control rack 26. Accordingly, the follower 142 is pivoted counterclockwise by the spring 144 at this time due to the configuration of the phase cam 140 in this portion of the cycle of rotation of the print shaft 12.

This results in the spring 144 pulling the phasing link 143 rearwardly (upwardly as viewed in FIGS. 2-4).

The initial rearward movement of the phasing link 143 results in the bellcrank 159 pivoting clockwise about the rod 21 due to the force of the springs 171 of the pawls 15-17. The portions 170 of the pawls 15-17 are bearing against the arm 169 of the bellcrank 159.

This force on the arm 169 of the bellcrank 159 by the springs 171 is sufficient to pivot the bellcrank 159 clockwise about the rod 21 to cause counterclockwise pivoting of the locking lever 160. This withdraws the surface 168 of the locking lever 160 OUT of locking engagement with the pawls 18-20 by removing the surface 168 from resiliently urged contact with the surfaces 168' of the pawls 18-20.

Accordingly, as the phasing link 143 continues to move rearwardly, the lug 145 on the arm 146 moves into the notches 147-149 of the pawls 18-20, respectively, to return the pawls 18-20 to the position of FIG. 2 where they are removed from coupling with the control rack 26. Accordingly, this arrangement insures that the holding pawls 15-17 are again coupled to the holding rack 23 before the pawls 18-20 are uncoupled from the control rack 26. This insures that the printing head 10 is held at the new position.

As previously mentioned, the pawls 18-20 are pivotally mounted about the rod 21. However, they also are capable of sliding relative thereto through each of the pawls 18-20 having an elongated slot 172

through which the rod 21 extends. This is necessary to enable the pawls 18-20 to be moved relative to each other between the positions of FIGS. 3 and 4.

Considering the operation for printing a character on the printing head 10 at the printing point, the start of the cycle begins with pressing a key downwardly as indicated in FIG. 7. This results in various of the slides 93-99, 109, and 110 of the logic device 92 being displaced from their home positions. This causes various of the channels A-1 to A-15, B-1 to B-18, C-1 to C-6, D-1 to D-17, E-1 to E-7, and F-1 to F-19 to provide flow paths for pulses of pressurized gas therethrough.

As shown in FIG. 7, the slides 93-99, 109, and 110 complete their motion to their displaced positions at 173. When this occurs, the pressure of the pump 90 begins to build up due to the cam 132 being rotated by the filter shaft 108. Shortly after the pressure of the pump 90 begins to increase, movement of any of the actuators 76, 80, and 85, which are to be moved, occurs to produce motion of the related levers 60-63.

At the same time that the bellows actuators 76, 80, and 85 begin to expand, the cycle clutch actuator, which controls the clutch for the print shaft 12, also begins to move. Accordingly, at the completion of the motion of any of the actuators 76, 80, 85, the print shaft 12 begins to rotate as indicated at 174 in FIG. 7 since the cycle clutch actuator completes its motion when the actuators 76, 80, and 85 complete their movements. Thus, the channel A-7 in the logic device 92 is formed during each selection of a character since the slide 99 is moved from the home position during each selection of a character on the printing head 10 for printing.

As the print shaft 12 begins to rotate, the cam 51 on the print shaft 12 causes the driver 31 to move forwardly for a predetermined distance. The start of this forward motion of the driver 31 is indicated at 175 in FIG. 7. The cam 51 has a dwell thereon so that the driver 31 ceases its initial forward motion at 176 in FIG. 7. This initial forward motion of the driver 31 causes the holding latch 59 to complete its clockwise pivoting and the stop 38 to complete its clockwise pivoting.

The mass of the holding latch 59 is much smaller than the mass of the stop 38 so that the holding latch 59 completes its clockwise pivoting much earlier than the stop 38 completes its pivoting. Thus, the holding latch 59 completes its motion so that it retains any of the actuated levers 60-63 by the time that the pressure from the pump 90 starts to decrease as indicated at 177 in FIG. 7. This arrangement insures that any of the levers 60-63, which have been actuated, are held in their actuated positions until completion of rotation of the print shaft 12.

After the stop 38 completes its movement to present the desired surface of the set of stepped surfaces 39 for cooperation with the lug 40 on the control rack 26 and during the remainder of the time when the driver 31 remains in its first forward position, the selected character is printed. The various selection actuators, which are controlled through the channels A-1 to A-6, are selected to position the selected character for printing.

The pawls 18-20 are moved into engagement with the control rack 26 during this dwell of the driver 31.

The completion of the engagement of the pawls 18-20 with the control rack 26 is indicated at 178. The motion of the pawls 18-20, as previously described, is controlled by movement of the phasing link 143 in the forward direction by the phasing cam 140, which also is responsive to rotation of the print shaft 12.

Upon completion of the pawls 18-20 engaging the control rack 26, the holding pawls 15-17 are withdrawn from the holding rack 23 by the arm 169 of the bellcrank 159. The completion of pivotal movement of the holding pawls 15-17 by the bellcrank 159 is indicated at 179, which is slightly prior to the time at which the driver 31 is again moved forward by the cam 51.

It should be understood that the holding pawls 15-17 are withdrawn from the holding rack 23 prior to the holding pawls 15-17 completing their pivotal movement as indicated at 179 so that there is no connection of the carrier 11 with the holding rack 23 when the driver 31 starts its forward motion. Accordingly, this forward motion of the driver 31 causes the notch 30 of the driver 31 to receive the lug 32 of the bellcrank 33 to move the control rack 26 forwardly until one of the stepped surfaces 39 engages the lug 40 on the control rack 26. The timing diagram of FIG. 7 shows the control rack 26 moving nine units.

The driver 31 is advanced in the forward direction by the cam 51 until another dwell on the cam 51 is reached as indicated at 180 in FIG. 7. When this occurs, forward movement of the driver 31 stops.

Then, the phasing cam 140 reaches the position in which the phasing link 143 is moved rearwardly by the spring 144 to allow the holding pawls 15-17 to return into engagement with the holding rack 23. When this movement of the pawls 15-17 into engagement with the holding rack 23 is completed as indicated at 181 in FIG. 7, the pawls 18-20 are withdrawn from engagement with the control rack 26.

When the control rack 26 is no longer held by the pawls 18-20 as indicated at 182 in FIG. 7, the spring 35 returns the control rack 26 to its home position since the driver 31 has started to be reversed in its direction of motion at 183 in FIG. 7 due to the spring 34' being effective to move the driver 31 in the rearward direction. Thus, as soon as the driver 31 starts to reverse its direction, the control rack 26 begins to follow this movement since the lug 32 on the bellcrank 33 is no longer urged by the driver 31. Therefore, the control rack 26 begins to move toward its home position at 184 in FIG. 7; this is slightly after the pawls 18-20 complete their motion as indicated at 182.

The motion of the control rack 26 shows damping of the spring 35 near the end of the motion of the control rack 26. When this damping ceases, the control rack 26 is disposed in its home position.

During the time that the driver 31 is moving in the rearward direction, the print shaft 12 ceases to rotate. This is indicated at 185 in FIG. 7.

As the driver 31 moves rearwardly, the holding latch 59 and the stop 38 are returned to their home positions due to the flange 55 of the driver 31 engaging the lug 56 on the stop 38 and the lug 59a on the holding latch 59. As shown in FIG. 7, the holding latch 59 and the stop 38 complete their motion at the same time as the driver 31 does.

However, the activated levers 60-63 do not complete their motion until slightly after the holding latch 59 has completed its motion. This is because of the mass of the activated levers 60-63, which cannot be released for return to their home positions until the holding latch 59 has almost completed its return to the home position.

When a backspace operation is to occur, the backspace actuator 42 receives a pulse of pressurized air from the pump 90 through the logic device 92 by means of the hose or conduit 43. Thus, the actuator 42 is actuated in the same manner and at the same time as the actuators 76, 80, and 85 are indicated as being actuated in the timing diagram of FIG. 7 when a character is to be selected or a character backspace is to occur.

It should be understood that the hose or conduit 43 connects with either the channel A-14 or the channel A-15 for a backspace operation through the output manifold 120'. When only a single unit of backspace motion is to be imparted to the control rack 26, the channel A-14 is satisfied through depressing the backspace key on the typewriter.

However, when a character backspace is to occur that is equal to the units of width of a particular character, which has been printed, then the particular character key is depressed as well as the code key 111. The actuation of the code key 111 causes the channel A-15 to connect the conduit or hose 43 with the pump 90. At the same time, the stop 38 is positioned in accordance with the depressed character key. This produces automatic backspacing for the units of width of the previously printed character.

To return the printing head 10 to the left side of the paper to begin another writing line, it is necessary to release the pawls 15-17 from engagement with the fixed rack 23 without the pawls 18-20 being moved into engagement with the control rack 26. The pawls 15-17 are withdrawn from engagement with the fixed rack 23 by pivoting a homing lever 190 counterclockwise (see FIG. 1B) about the rod 21. The counterclockwise pivoting of the homing lever 190 is produced by supplying a pulse of pressurized gas such as air, for example, through a hose or conduit 191 to a bellows actuator 192, which is mounted on the bracket 22 and contacts a portion of the homing lever 190. The hose or conduit 191 is connected to the logic device 92 and receives a pulse of pressurized gas when the channel A-13 is satisfied.

When the homing lever 190 pivots counterclockwise, an arm 193 on the homing lever 190 engages all of the pawls 15-17 to pivot them counterclockwise about the rod 21 and against the force of their springs 171. Therefore, the printing head 10 is no longer coupled to the fixed rack 23. This movement of the pawls 15-17 does not affect the pawls 18-20, which remain uncoupled from the control rack 26.

Since the pressurized gas to the bellows actuator 192 is a short pulse, it is necessary to retain the holding pawls 15-17 out of engagement with the holding rack 23 after the bellows actuator 192 ceases to receive the pressurized gas. Accordingly, when the homing lever 190 pivots counterclockwise about the rod 21, an arm 194 on a homing lever latch 195, which is pivotally mounted on a lower horizontal portion 196 of the bracket 22, is moved into engagement with a shoulder

197 of the homing lever 190 is pivoted counterclockwise by the actuator 192. This movement of the arm 194 on the latch 195 is due to the force of a spring 198, which has its ends secured to the portion 196 of the bracket 22 and the arm 194 of the latch 195 and is continuously urging the latch 195 clockwise.

At the same time that the actuator 192 receives the pressurized gas, an actuator (not shown) for a carrier return spring clutch also is activated in the same manner through the channel A-11 being satisfied. This activates a clutch to initiate a carrier return operation wherein the printing head 10 is returned to the start of another writing line. One suitable example of a suitable carrier return spring clutch mechanism is shown and described on pages 52-55 of Instruction Manual Form Part No. 241-5032-2 of International Business Machines Corporation, Armonk, New York, published Jan. 1966. It should be understood that the paper is advanced at the same time in a manner such as that shown and described in the aforesaid Instruction Manual on pages 56-59.

A tab pawl 199, which also is pivotally mounted on the rod 21, is designed so that it can move in the backspace or carrier return direction relative to the fixed rack 23 by ratcheting over the teeth 22' of the rack 23 but will stop any movement in the forward direction. Accordingly, when the carrier return spring clutch actuator is inactivated, the tab pawl 199, which is continuously biased toward the holding rack 23 by a spring 200 having one end connected to the bracket 22 and its other end secured to the tab pawl 199, prevents the printing head 10 from moving in the forward direction. This holds the printing head 10 at the left end of the typewriter to begin printing another line.

The pawls 15-17 are held out of engagement with the fixed rack 23 by the arm 193 of the homing lever 190 through the homing lever 190 being retained by the arm 194 of the latch 195 until the next cycle of rotation of the print shaft 12. During the next cycle of operation, the bellcrank 159 rotates counterclockwise, as previously mentioned, during the first portion of the cycle rotation of the print shaft 12 so that the homing lever latch 195 is pivoted counterclockwise against the force of the spring 198 by a horizontally disposed lower finger 201 of the arm 169 of the bellcrank 159 engaging an upstanding arm 202 of the homing latch 195. This removes the arm 194 of the latch 195 from engagement with the shoulder 197 and positions it as shown in FIG. 1B so that the homing lever 190 is pivoted clockwise about the rod 21 by a spring 203, which has one end attached to the homing lever 190 and its other end fixed to the carrier bracket 22.

This removes the arm 193 of the homing lever 190 from engagement with the pawls 15-17 whereby they are now held out of engagement with the holding rack 23 by the arm 169 of the bellcrank 159 until rearward movement of the phasing link 143 occurs. Thus, the arm 194 of the homing lever latch 195 is again disposed within a notch 204 in the homing lever 190 and urged against a shoulder 205 of the homing lever 190. After the arm 169 starts to control the pawls 15-17, the remainder of the movement of the pawls 15-17 is the same as previously described for a print operation.

Whenever a tab operation is desired, the bellows actuator 192 is activated to pivot the homing lever 190

counterclockwise. At the same time, a pulse of pressurized gas such as air, for example, is supplied through a hose or conduit 206, which is connected to the pump 90 through the logic device 92, to a bellows actuator 207, which is mounted on the bracket 22 and contacts a tab lever 208. The pulse is supplied to the actuator 207 when the channel A-12 is satisfied.

The activation of the actuator 207 pivots the tab lever 208 counterclockwise about the rod 21. A downwardly depending arm 209 (see FIG. 5) on the tab lever 208 engages the tab pawl 199 to cause the tab pawl 199 to also pivot counterclockwise. The tab lever 208 has an elongated slot 210 through which the rod 21 extends so that there can be axial motion of the tab lever 208 relative to the rod 21 in addition to pivotal motion of the tab lever 208 about the rod 21.

The pivoting of the tab lever 208 and the homing lever 190 results in none of the pawl 15-17 and 199 being engaged with the fixed rack 23 since the holding pawls 15-17 are removed from the holding rack 23 by the homing lever 190 and the tab pawl 199 is removed by the tab lever 208. Thus, the printing head 10 is not coupled to either the holding rack 23 or the control rack 26 and freely moves in the forward direction due to the force of the main spring (not shown) acting on the carrier 11 in the manner more particularly shown and described in the aforesaid Palmer U.S. Pat. No. 2,919,002.

When the tab lever 208 is pivoted counterclockwise about the rod 21 due to activation of the bellows actuator 207, an arm 211 on a tab latch 212 (see FIG. 1B), which is pivotally mounted on the bracket 22, is urged by a spring 213, which has its ends connected to the tab latch 212 and the bracket 22, into engagement with a shoulder 214 (see FIG. 5) on the tab lever 208. This retains the tab lever 208 in the position in which it holds the tab pawl 199 out of engagement with the fixed rack 23. Accordingly, when the pulse of pressurized gas ceases to be supplied to the bellows actuator 207, the tab pawl 199 is still held out of engagement with the fixed rack 23.

Accordingly, the movement of the carrier 11 continues in the forward direction until a tab stop 215 on a tab rack 216, which is secured to a portion of the frame of the typewriter, is engaged by a tab sensor 217. When the tab lever 208 is pivoted counterclockwise, the tab sensor 217 is moved into a position for engaging the tab stop 215.

The tab sensor 217 is pivotally mounted on the tab lever 208 by a shoulder screw 218 and is biased counterclockwise by a spring 219 so that an arm 220 of the tab sensor 217 engages a surface of the tab lever 208 to form a fixed engagement therebetween whereby the engagement of the tab stop 215 with the sensor tab 217 is the engagement of two fixed elements. The spring 219 allows any clockwise movement of the tab sensor 217 about the screw 218 so that the tab sensor 217 ratchets over any of the tab stops 215 during any movement in the backspace direction with the tab lever 208 pivoted to the position in which the tab sensor 217 can engage any of the tab stops 215.

When the tab sensor 217 engages the next of the activated tab stops 215 after the tab lever 208 has been pivoted counterclockwise, the engagement of the tab sensor 217 with the tab stop 215 causes movement of

the tab lever 208 in the rearward or backspace direction. The slot 210 allows this axial motion relative to the rod 21.

This axial motion in the rearward direction by the tab lever 208 removes the shoulder 214 of the tab lever 208 from engagement with the arm 211 of the tab latch 212. When this occurs, the force of the spring 213 urges the tab latch 212 clockwise until a lug 221 (see FIG. 1B) on the latch 212 engages a finger 222 on the carrier bracket 22. This limits the clockwise movement of the tab latch 212 by the spring 213 to insure that the arm 211 of the tab latch 212 is disposed to cooperate with the tab lever 208 when it returns to the normal position. When the arm 211 of the tab latch 212 ceases to engage the shoulder 214 of the tab lever 208 and is pivoted clockwise by the spring 213, a spring 223 (see FIG. 5) pivots the tab lever 208 clockwise about the rod 21 to withdraw the arm 209 from engagement with the tab pawl 199. This allows the spring 200 to pivot the tab pawl 199 clockwise about the rod 21 to return the tab pawl 199 into engagement with the fixed rack 23 to stop movement of the carrier 11 in the forward direction.

While the present invention has shown and described the type head 10 as being movable and the platen 14 being fixed, it should be understood that the present invention may be readily employed with a typewriter having a movable platen that moves relative to a fixed printing point to which type bars are selectively directed. In this type of typewriter, the control rack 26 would be connected to the movable platen. While the present invention has been described with respect to a typewriter, it should be understood that it may be employed with any printer in which it is desired to control movement between the printing point and the paper on which there are printed characters.

An advantage of this invention is that it enables a single element printing head to have proportional spacing. Another advantage of this invention is that it permits a constant stroke input to drive a letter feeding part variable increments in either direction. A further advantage of this invention is that a control member may be moved in both directions by eliminating the use of a one directional bias on a control member with the bias opposed by a positive drive to move the control member in only a single direction. Still another advantage of this invention is that it eliminates the need for a lead screw for moving a carrier having a single element printing head. A still further advantage of this invention is that it uses substantially the same structure for proportional spacing in both forward and reverse directions.

While the invention has been 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 details may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. A printer having frame means, means defining a printing point, and a letter feeding part that is movably supported on said frame means to effectively displace the printing point along a writing line, wherein the improvement comprises:

an elongated holding member mounted normally sta-

tionarily on said frame means and substantially parallel to the writing line;

an elongated positioning member movably mounted on said frame means adjacent and substantially parallel to said holding member and the writing line for movement in the direction of its elongation in forward and reverse directions along the writing line;

means for coupling said letter feeding part selectively with said holding and positioning members and including cyclically operable means for sequentially coupling said letter feeding part to said positioning member and uncoupling said letter feeding part from said holding member followed by coupling said letter feeding part to said holding member and uncoupling said letter feeding part from said positioning member;

said coupling means including:

first connecting means cooperating with said holding member;

second connecting means cooperating with said positioning member to secure said letter feeding part to said positioning member for simultaneous movement with said positioning member in either the forward or reverse direction;

and means to control movement of said first and second connecting means to retain said first connecting means in cooperating relation with said holding member until said second connecting means is cooperating with said positioning member and then to disconnect said first connecting means from said holding member and vice versa;

and means for displacing said positioning member selectively in both forward and reverse increments along the writing line during times when said letter feeding part is coupled with said positioning member;

said displacing means including:

a source of displacing motion during each cycle of operation of the printer;

direction selection means for controlling motion from said source of displacing motion to said positioning member to move said positioning member in the forward and reverse directions;

an output control device;

and said output control device having means for selectively controlling said direction selection means to cause said positioning member to be driven in only one of the forward and reverse directions during each coupling of said letter feeding part and said positioning member.

2. The printer according to claim 1 in which: each of said holding and positioning members comprises a rack;

and each of said first and second connecting means of said coupling means comprises at least one pawl to engage said rack with which said pawl cooperates.

3. The printer according to claim 2 in which each of said first and second connecting means of said coupling means comprises a plurality of pawls to engage said rack with which said pawls cooperate.

4. The printer according to claim 1 in which: said displacing means includes:

increment measuring means;

and means to control said increment measuring means to produce varied increments of motion of said positioning member in at least the forward direction.

5. The printer according to claim 4 in which: said increment measuring means includes means to stop movement of said positioning member when said positioning member has been moved the desired increment in at least the forward direction; and said control means of said displacing means controls the position of said stop means in accordance with the desired increment of motion in at least the forward direction.

6. The printer according to claim 5 in which: said stop means includes means presenting various surfaces for cooperation with said positioning member depending on the desired increment of motion of said positioning member in at least the forward direction;

and said control means of said displacing means positions said presenting means to dispose only one of the surfaces of said presenting means for cooperation with said positioning member to stop said positioning member after movement of said positioning member the desired increment in at least the forward direction.

7. The printer according to claim 6 in which said presenting means presents a plurality of stepped surfaces for engagement with said positioning member during movement of said positioning member in at least the forward direction.

8. The printer according to claim 5 in which: said source of displacing motion is driven a constant stroke during each movement of said positioning member in at least the forward direction;

and yieldable means connects said source of displacing motion to said positioning member, said yieldable means deforming when said positioning member is stopped by said stop means during movement of said positioning member in at least the forward direction to absorb the continued movement of said source of displacing motion until said source of displacing motion completes said driven constant stroke.

9. The printer according to claim 4 in which said control means of said displacing means includes means responsive to the selected action of the printer to determine the increment of motion of said positioning member.

10. The printer according to claim 1 in which: said displacing means includes: increment measuring means;

and means to control said increment measuring means to produce varied increments of motion of said positioning member in both forward and reverse directions.

11. The printer according to claim 10 in which: said increment measuring means includes means to stop movement of said positioning member when said positioning member has been moved the desired increment;

and said control means of said displacing means controls the position of said stop means in accordance with the desired increment of motion.

12. The printer according to claim 11 in which:

said stop means includes means presenting two sets of various surfaces for cooperation with said positioning member depending on the desired increment of motion of said positioning member in the selected direction;

and said control means of said displacing means positions said presenting means to dispose only one of the surfaces of one of said sets of surfaces of said presenting means for cooperation with said positioning member to stop said positioning member after movement of said positioning member the desired increment in the selected direction.

13. The printer according to claim 12 in which each of said sets of surfaces comprises a plurality of stepped surfaces.

14. The printer according to claim 11 in which: said source of displacing motion is driven a constant stroke during each movement of said positioning member in either direction;

and yieldable means connects said source of displacing motion to said positioning means, said yieldable means deforming when said positioning member is stopped by said stop means during movement of said positioning member in the forward or reverse direction to absorb the continued movement of said source of displacing motion until said source of displacing motion completes said driven constant stroke.

15. The printer according to claim 10 in which said control means of said displacing means includes means responsive to the selected action of the printer to determine the increment of motion of said positioning member.

16. A printer having frame means, means defining a printing point, a letter feeding part that is movably supported on said frame means to effectively displace the

printing point along a writing line and movable in either of two mutually opposed directions, and a cyclically displaced input member that is moved through a substantially constant stroke during each cycle of operation of the printer, wherein the improvement comprises:

selective stop means for limiting movement of said letter feeding part along its path in either of the directions;

and means connecting said input member to said letter feeding part including motion direction selecting means to transfer the constant stroke of said input member to motion of said letter feeding part in either of the mutually opposed directions;

said connecting means including a single spring so that said letter feeding part is driven by said input member until said letter feeding part encounters said stop means and said single spring deforming in either direction depending on the direction of movement of said letter feeding part so that further movement of said input member occurs until said input member completes its substantially constant stroke.

17. The printer according to claim 16 in which: said stop means has first and second sets of surfaces for cooperation with said letter feeding part; and means to dispose one of the surfaces of one of said sets for cooperation with said letter feeding part to determine the movement of said letter feeding part by said input member.

18. The printer according to claim 17 in which each of said sets of surfaces comprises a plurality of stepped surfaces.

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