

April 25, 1967

A. SCHONFELD

3,315,775

FLUID ACTUATED TYPEWRITER

Filed Aug. 27, 1965

2 Sheets-Sheet 1

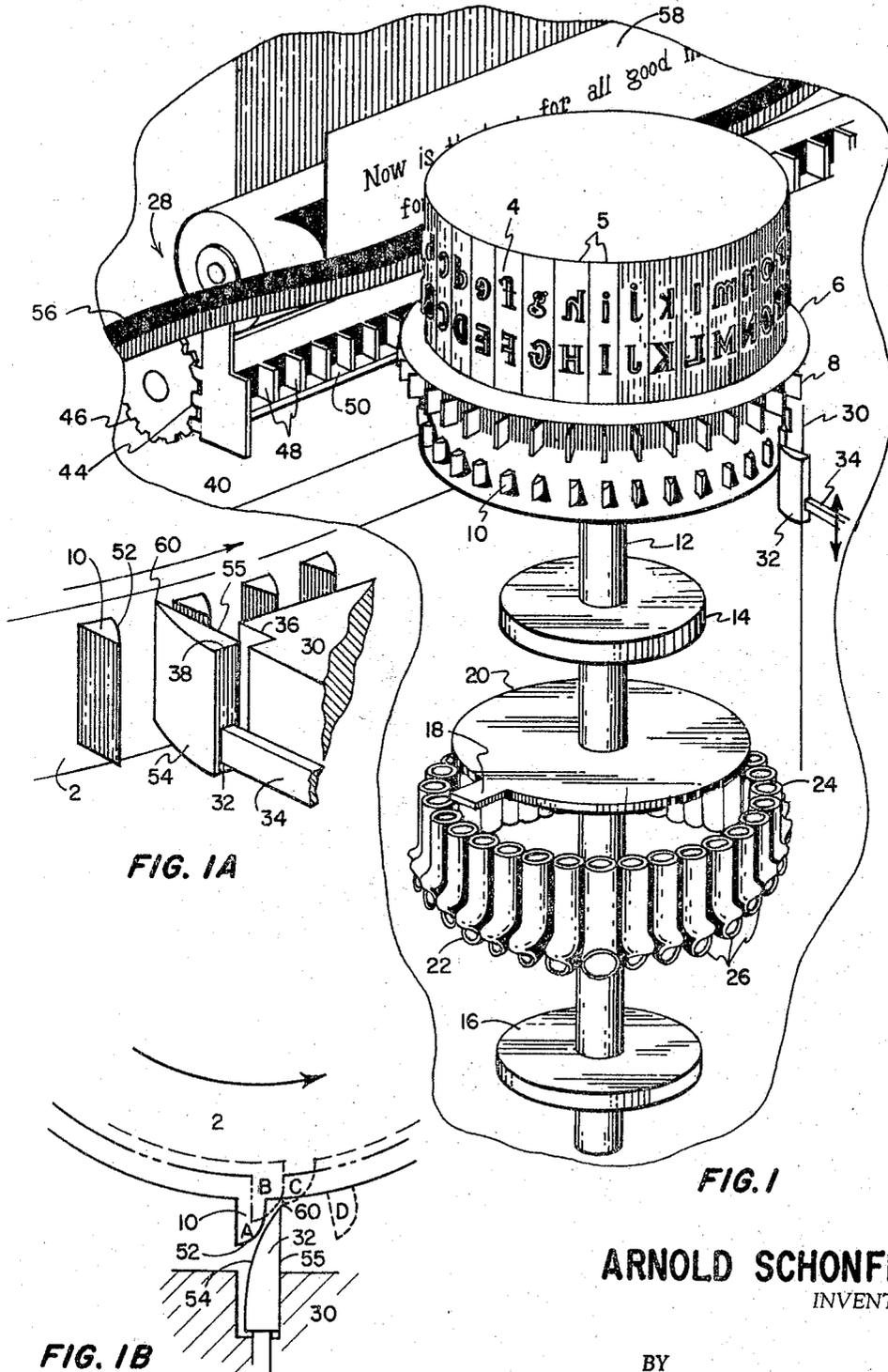


FIG. 1A

FIG. 1

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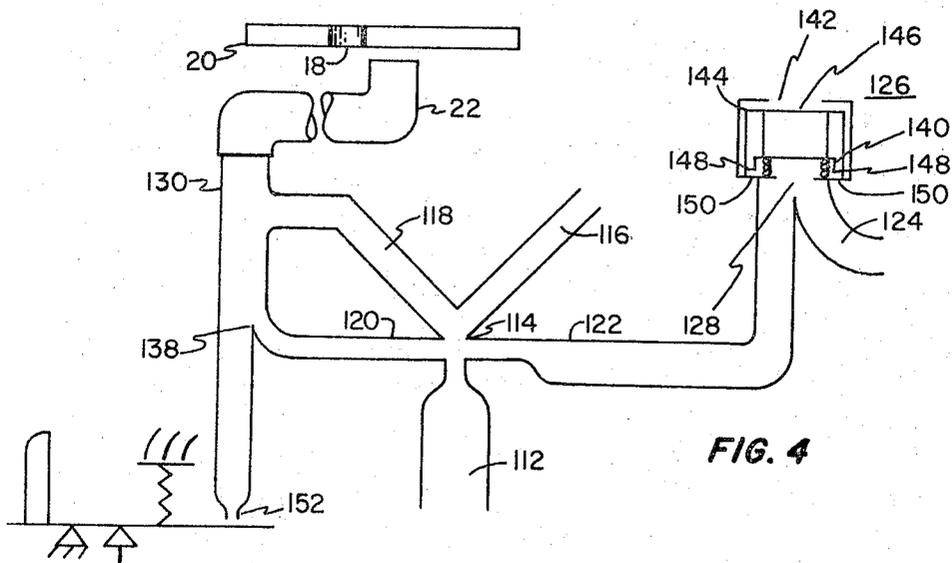
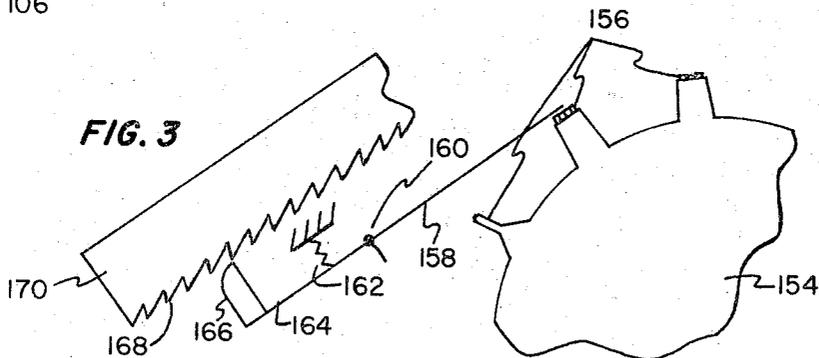
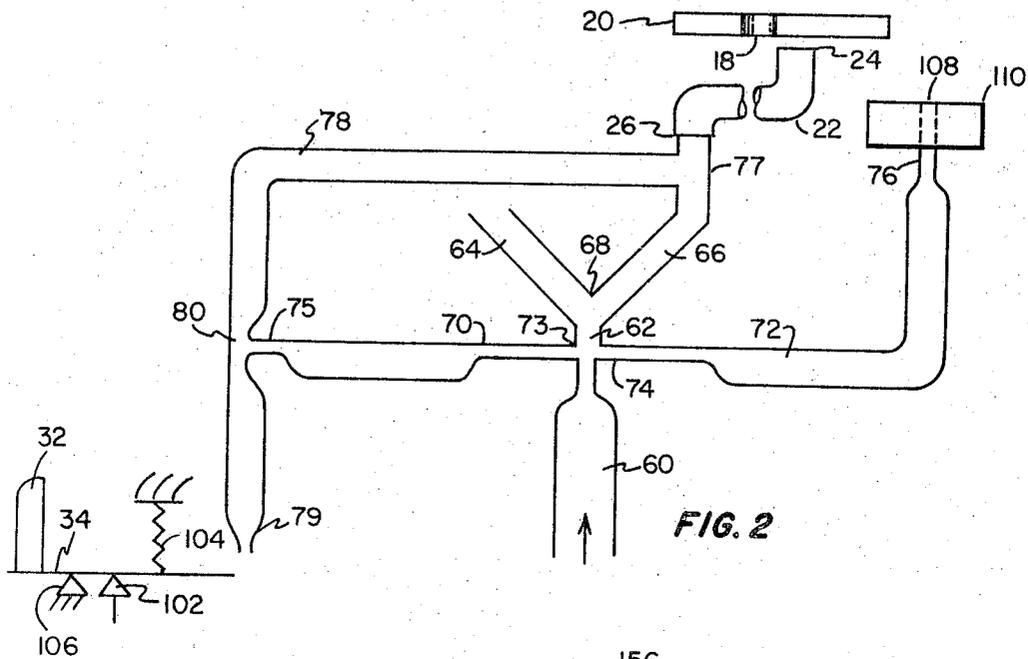
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2 Sheets-Sheet 2



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FLUID ACTUATED TYPEWRITER

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24 Claims. (Cl. 197-15)

This invention relates to typewriters and more particularly to a typewriter wherein the print elements thereof are selectively actuated by means of fluid pressure.

Some of the earliest typewriters were fluid operated. Those typewriters, however, tended to be very slow, cumbersome, and not at all practical for use in business offices. Consequently, fluid operated typewriters never quite came into their own. However due to a recent surge in the use of fluid operated devices a desire for fluid operated typewriters has once again arisen. Accordingly, it is an object of this invention to provide a simple, high-speed, fluid operated typewriter which has general utility for use in business offices and the like.

In most of the prior art devices it requires quite some skill for an operator to know just how hard to push a fluid typewriter key and how long to hold the key in a depressed condition. Hence, it is another object of this invention to require that the operator merely touch a selected key in order that a corresponding character be printed upon a printing medium.

One of the reasons that the prior art fluid operated typewriters were so slow is that it took a relatively long period of time for a selected key to return to a neutral state whereby it could again be selected. Therefore it is an object of this invention to provide a fluid operated typewriter wherein selected keys are returned to a neutral state both rapidly and automatically thereby permitting rapid sequential printing of previously selected characters.

It is another object of this invention to provide a typewriter wherein the mere depression of a key actuates an automatic erasing mechanism.

Fluid systems tend to be very sensitive to impurities that become lodged in their flow paths. In a fluid typewriter, for example, a fluid flow path that is blocked by impurities can cause printing errors or blank spaces to appear on the printing medium. It is therefore an object of this invention to provide a fluid operated typewriter which is adapted to purge its more vulnerable fluid flow paths of impurities.

It is another object of this invention to provide a fluid typewriter wherein the spacing between successively printed characters is proportional to the width of those characters.

In most present day typewriters a character is printed upon a printing medium by striking a ribbon or the like against the printing medium by means of a print hammer. It is an object of this invention to provide a typewriter wherein the selected character is "rolled" on to the printing medium rather than being placed thereon in a striking motion. In this manner, the thusly printed medium has a smooth surface finish rather than the randomly indented finish usually obtained.

The invention is intended for use in a typewriter of the type in which one or more character elements are located on each of a plurality of print elements mounted on the surface of a rotatable type wheel. When it is desired that a particular character be printed upon a printing medium the type wheel is brought into engagement with the medium when the selected character element has been rotated into a printing position. In accordance with the principle of the invention a fluid amplifier is associated with each of the printing elements. These fluid amplifiers are of a substantially standard variety, each having an input channel, first and second output channels, and at least one control channel and wherein the fluid normally flows from

the input channel into one of the output channels. Each of the print elements has a typewriter key associated with it, the actuation of which changes the fluid pressure in a control channel of the corresponding fluid amplifier so that the output thereof is directed into the other output channel. The typewriter of the invention has a timing means for directing fluid from the second output channel to a print actuation means when the desired character's print element is rotated into its printing position. The print actuation means is then operative in response to the fluid from the second output channel for moving the rotatable type wheel through a print operation at the printing station whereby the selected character is impressed upon the printing medium.

Because fluid amplifiers have no moving parts, a decided advantage of the instant typewriter is that the instrument as a whole has far fewer parts, higher reliability, and lower initial cost than the typewriters presently available in the commercial market. Moreover, the typewriter of the invention is smaller and lighter than the conventional machine and has the additional advantage that the keys thereof need only be touched. Hence, there is an additional savings in time in that no depression of the keys is required.

The foregoing and other objects, features, and advantages of the invention will be apparent from the following more particular description of preferred embodiments of the invention as illustrated in the accompanying drawings in which like reference characters refer to the same parts throughout the different views. The drawings are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the invention.

In the drawings:

FIG. 1 is a perspective view of a rotary type wheel and associated mechanisms used in a preferred embodiment of the invention;

FIG. 1a is a perspective view of a cam surface on a rotary type wheel as it is about to coact with an interposer used in a preferred embodiment of the invention;

FIG. 1b is a schematic plan view illustrating the coaction between the cam surface and the interposer of FIG. 1a.

FIG. 2 is a schematic diagram of a preferred embodiment of a fluid amplifier used in combination with the structure of FIG. 1 to comprise a typewriter embodying the invention;

FIG. 3 is a schematic plan view of a proportional spacing mechanism included in an alternative embodiment of the invention; and,

FIG. 4 is a schematic view of an alternative fluid amplifier which is suitable for use with an alternative embodiment of a typewriter embodying the invention.

Referring now to FIG. 1: a type wheel 2 has placed thereon a series of raised character elements 4 each of which is located on a print element 5 mounted at a predetermined location on the surface of the type wheel. In the illustrated embodiment two rows of character elements are shown, the one row being for lower case characters and the other row being for upper case characters. Various other symbols such as numerals, hyphens, quotation marks and the like, although not specifically shown, are similarly located around the circumference of the type wheel. Directly below the row of upper case character elements is an O-ring 6 which may be made of any material which is suitable for erasing the printed characters from the printing medium.

Each of the print elements has associated therewith a carriage step member 8 protruding from the surface of the type wheel below the related print element. Similarly, each of the print elements has associated therewith a type wheel deflector 10. The type wheel deflectors are

also located about the surface of the type wheel in a ring below the carriage step members as shown. The type wheel and its associated elements are fastened to a flexible shaft 12 which is rotatably mounted in bearings 14 and 16 which are pressed into the typewriter housing which, for reasons of simplicity, has been broken away and therefore has not been shown. A timing tab 18 extends radially from a timing tab wheel 20 which is fixed to the shaft 12 for rotation therewith. A series of detector tubes 22 are located in a ring which is coaxial with the shaft 12. The detector tubes are held in position by a detector bracket, not shown, so that the timing tab 18 skims over the upper surfaces 24 of the detector tubes, sequentially covering each of the tubes as it rotates. Each of the detector tubes is associated with a particular print element and each of the tubes is connected at its lower end 26 to an output channel of a corresponding fluid amplifier, preferred embodiments of which will be described later.

The rotating type wheel 2 is located within the typewriter housing between a carriage mechanism 28 and a wall 30. An interposer 32 is mounted on an arm 34 which is movable vertically as shown in the drawings by an arrow. The wall 30 is recessed at 36 (FIG. 1a) and accommodates corner 38 of the interposer during its vertical motion as shown in FIG. 1a. As will be described more fully later, the interposer is selectively driven into its upper position in response to the output of a character selection signal from a selected fluid amplifier corresponding to the particular character which is desired to be printed. First, however, the coaction will be described between the interposer, the type wheel, and the carriage mechanism whereby a selected character is printed.

The carriage 28 is comprised generally of a carriage frame member 40 to which is rotatably fastened a suitable type of platen or roller mechanism 42. The rear portion of the carriage frame has teeth 44 extending across its length for engagement with corresponding teeth on a shift drive wheel 46. The forward portion of the carriage frame member 40 has carriage step teeth 48 located in a recess 50 thereof. The carriage step teeth are adapted to engage with the carriage step members 8 located on the type wheel when the type wheel is moved into a printing position as will now be described.

When a particular character is desired to be printed the output of the associated fluid amplifier, to be described later, is delivered through the detector tube 22 corresponding to the print element upon which the particular character is mounted. The embodiment of the invention being described employs only air as a fluid. Hence, the air is permitted to escape from the upper surfaces 24 of the detector tubes. Because the principle of operation between a gaseous fluid and a hydraulic fluid are identical insofar as the invention is concerned, no liquid embodiment will be described.

As the timing tab wheel 20 is rotated the timing tab 18 passes sequentially over the tops of the detector tubes. As it passes over the detector tube to which a selected fluid amplifier's output is directed, the fluid amplifier causes the interposer arm 34 and thereby the interposer 32 to move upwardly. This function of the timing tab permits the interposer to move between the type wheel deflectors 10 just as the print element containing the selected character approaches its printing position opposite the printing station on the carriage mechanism.

Referring now to FIGS. 1a and 1b, the coaction between the interposer 32 and the type wheel deflector tabs 10 will be described whereby the selected print element is brought into engagement with the printing medium. When the type wheel is rotated in the direction shown in FIG. 1a and whenever the interposer is in its uppermost position, the leading edge 52 of the type wheel deflector tab corresponding to the selected character engages with a camming surface 54 on the interposer and surface 55 on the interposer abuts recess 36 in the wall 30. When this

occurs the camming action between the surfaces 52 and 54, coupled with the rotation of the type wheel, causes the type wheel to move forwardly as it rotates. This action is illustrated in FIG. 1b. Therein, position A of the type wheel deflector 10 indicates the relative positions of the deflector and the interposer when the surfaces 52 and 54 first meet. As the type wheel continues to rotate the type wheel deflector is moved through position B and then into position C as the shaft 12 is urged from its vertical position in FIG. 1. Thus the selected character element is rolled forwardly against a ribbon 56 by means of which the selected character is printed upon a paper 58 positioned between the ribbon and the platen. As soon as the particular type wheel deflector passes the tip 60 of the interposer the resilience of the shaft 12 brings the type wheel back into the position D in FIG. 1b. By this time the timing tab 18 has passed over the particular detector tube 22 and the interposer is withdrawn to its lowermost position by means not yet described.

The cycle of operation just discussed was described as though the type wheel's print elements had only one row of character elements located thereon. Actually, as previously noted, the type wheel in the preferred embodiment has several rows of character elements located thereon as well as the erasing member 6. These various rows of character elements are brought into engagement with the ribbon at the printing station by moving the carriage assembly upwardly and downwardly by means of the shaft drive wheel 46. The erasing member is similarly brought into engagement with the printing medium while simultaneously raising or lowering the ribbon by a ribbon control means not shown. When it is desired to move the carriage assembly, a shift key not shown is operated to cause the carriage shift drive wheel 46 to rotate by any suitable means. In this manner, the selection of either a particular row of character elements or the erasing element can be effected so as to bring the particularly chosen element into engagement with the medium at the printing station. Because the shifting mechanism used in the typewriter of the invention can be of any one of several conventional types, this mechanism will not be further described herein.

At the same time that the selected character element is about to be brought into engagement with the ribbon at the print station the associated carriage step member engages with the carriage step teeth 48. Hence, as the type wheel rotates during the printing operation and while the character is rolled onto the paper 58 the carriage assembly is moved to the left in FIG. 1. When the type wheel is returned to its nonprinting position the carriage assembly is then held in place by a ratchet type of mechanism, which, again, being conventional, will not be further described.

The carriage step teeth 48 are large enough so that they are engaged by the carriage step members 8, no matter which of the rows of character elements are presently in a printing position. If more rows of character elements are used the carriage step teeth, of course, should be made proportionally larger.

When it is desired to use the erasing element 6 the ribbon 56 is moved downwardly as in the carriage frame 40. In this case, the carriage step teeth 48 are lowered below the carriage step members 8 so that motion of the type wheel towards the paper does not also involve a stepping of the carriage assembly to the left. When it is desired to erase, an erasing arm, not shown, causes the ribbon control means to remove the ribbon and also acts upon the housing of bearing 14 to flex the shaft 12 towards the paper 58 until the erasing element is brought into engagement with the paper. As will be apparent from the figure, the erasing function is accomplished by merely continuing to rotate the type wheel while the erasing element is thusly engaged with the paper.

Having described the mechanical structure and functions associated with the type wheel, reference will now

be made to FIG. 2 which illustrates a fluid amplifier circuit suitable for use in combination with the above described type wheel mechanism. It is the fluid amplifier circuit which provides the speed and timing accuracy without which the typewriter of the invention would be inoperative for its intended purposes. In FIG. 2, an input power stream illustrated by an arrow is delivered to an input channel 60 for entrance into a mixing chamber 62. Two output channels 64 and 66 exit from the mixing chamber, there being a Y portion 68 at their point of departure. The Y is offset slightly to the right of the center line of the power stream input channel thereby making the amplifier slightly asymmetrical. That is, fluid entering through the power input channel 60 normally exits through output channel 64. Moreover, the fluid continues to exit through channel 64 unless an outside influence is exerted upon the fluid flow. On the other hand (again in the absence of additional outside influences), once the fluid is caused to shift into output channel 66 it will remain flowing in that channel until otherwise directed. The preferred fluid amplifier, therefore, is only asymmetrical to the extent that in the absence of outside influences, fluid entering through channel 60 will, of its own accord, choose to exit through channel 64. The desired outside influences are supplied to the mixing chamber 62 by means of control channels 70 and 72 which have control ends 73 and 74 and input ends 75 and 76, respectively. These control channels operate in a conventional manner. For example, when the pressure at control end 73 of control channel 70 becomes greater than the pressure at control end 74 of control channel 72 the fluid output stream which normally exits through channel 64 switches over and exits through channel 66. This is accomplished by either making the pressure in control channel 70 larger or making the pressure in control channel 72 smaller. Once the fluid output is directed into channel 66 it enters into one or the other of channels 77 or 78 as will be described shortly. If the fluid is directed into channel 78 it passes out of an exit nozzle 79 after having passed over a venturi section 80 which is connected to input end 75 of control channel 70 as shown.

The lengths of both control channel 70 and the exit channel 78 may be varied in order to vary the flow times of fluid from one point in the circuit to another.

Located directly under the exit nozzle 79 is one end 100 of the arm 34 which is attached to the interposer 32. The interposer arm pivots about 102 and is biased for motion in a counterclockwise direction by a spring 104 but limited in said motion by a stop member 106.

Having described the structure of a preferred embodiment of a fluid amplifier which is suitable for use in the typewriter of the invention the operation thereof will now be described. It should be understood, however, that although the following description covers only one such fluid amplifier that there is a similar amplifier circuit associated with each print element on the type wheel. This is, of course with the exception of the interposer portion which is common for all characters. In other words, the operation of the fluid amplifier will be described as though it is the particular amplifier associated with the particular character which is desired to be printed at the moment.

Prior to the time that a particular character is selected for printing, fluid flows through the power input channel 60 and out of the exit channel 64. In doing so air (in the illustrated embodiment) is pulled in through control channels 70 and 72 by virtue of the entrainment effect of the power-input stream as it passes over the control ends 73 and 74 of the control channels. When it is desired to print the particular character, opening 108 is blocked such as by an operator's finger on a corresponding key 110. Opening 108 is connected to the input end 76 of the control channel 72. Hence, with the opening 108 covered, a vacuum is pulled in the control channel 72 causing the pressure at control end 74 to become lower

than the pressure at 73 and the amplifier's output to switch from exit channel 64 into exit channel 66. The flow from exit channel 66 extends upwardly into channel 77 from whence it enters the associated detector tube 22 at the lower end thereof and passes into the atmosphere from its upper end 24. As soon as the timing tab skirts over the top surface 24 of the detector tube 22, however, the flow of air therefrom is substantially blocked causing the flow from channel 77 to be diverted into channel 78 and exit through nozzle 79. The rush of air out of nozzle 79 forces end 100 of the interposer arm 34 downwardly causing said arm to pivot about point 102 and thus cause interposer 32 to rise between surface 36 of the carriage wall 30 and surface 52 of the type wheel deflector 10 associated with the particular character. Hence, the character corresponding to the selected key 110 is printed upon the medium 58 in the manner described above.

As soon as the timing tab 18 moves past the particular detector tube the air flow is once again directed back into exit channel 77 from channel 78. Very shortly thereafter air ceases to flow out of nozzle 79 whereby the bias of spring 104 returns the interposer 32 to its neutral position against the stop 106.

Because the fluid amplifier is only slightly asymmetrical, however, the fluid flow does not switch into exit channel 64 until an outside influence is exerted at the mixing chamber 62. This is accomplished when the fluid from channel 78 passes over the venturi section 80, thereby pulling a vacuum at the input end 74 of control channel 70. This lower pressure is reflected at the control end 73 and the input power stream shifts into the neutral output channel 64 from whence it began.

After a printing operation, and after the interposer has returned to its neutral position, the type wheel continues to rotate until another detector tube is activated and the process is repeated.

By varying the lengths of channels 70 and 78 the relative timings between the passage of timing tab 18 over the related detector tube 22, application of air pressure for urging the interposer 32 upwardly, and the return of the fluid amplifier's output to its neutral output channel 64, are regulated. Because this is done in accordance with established principles of fluid amplifiers design, however, it will not be further discussed.

It will be appreciated by those skilled in the art that all that is required for a printing operation to occur is for a momentary blockage of the control channel 72—in this embodiment by means of port 108 in key 110—whereby the fluid amplifier's output is switched into the active output channel 66. Hence, there is no necessity for a typewriter operator, for example, to hold his finger on the selected key for any particular length of time. Moreover, by virtue of the vacuum drawn by the venturi section 80, the amplifier is automatically returned to its neutral state after a printing operation, thereby permitting the same character to be printed again almost immediately, a facility quite uncommon among the fluid operated typewriters of the prior art.

When the shaft 12 is turned by a relatively low speed motor—1800 r.p.m. for example—the machine is limited to about 360 five letter words per minute. Moreover, this assumes that the timing wheel would be required to make a complete revolution between each printing operation. If it is assumed that the timing wheel is only required to rotate one-half of a revolution between printing operations, the machine's limitation jumps to about 720 five letter words per minute. Because fluid amplifiers are able to operate at thousands of cycles per second, the fluid amplifiers of the invention impose no practical speed limitations upon the typewriter. Of course the above machine limitations far exceed the maximum rate of even the fastest typists. Hence, the speed increases of the instant device over prior art typewriters take on little significance in that respect. For automatic data processing installations, however, the typewriter imposes its own speed limi-

tations. Hence, when considered for use in connection with an automatic data processing installation the speed increase of the typewriter of the invention takes on great significance.

Similarly, the erasing feature of the instant typewriter takes on greater significance when it is understood that the typewriter is particularly compatible with fluid operated data processing mechanisms. Most data processing systems are capable of automatically detecting certain system errors. Hence, by providing an erasing element that is integral with the typewriter itself, it will be appreciated that a detected error can be automatically erased and easily reprinted.

The type wheel and the timing tab wheel, being mounted on the same shaft, rotate at the same angular velocity. Hence, the timing tab always has a fixed relationship to each print element. In addition, the detector tubes are arranged so that the timing tab is above a particular tube when its associated print element is in its printing position. Consequently, because the position of the interposer is fixed relative to the print station, the appearance of the timing tab over a particular detector tube causes the related character to be printed. It will be appreciated, therefore, that the timing arrangement of the instant fluid typewriter is quite simple in both structure and operation. Moreover, if desired, this timing sequence can be adjusted very simply, merely by altering the lengths of channels 70 and 78 in the related fluid amplifiers.

The above described typewriter also imprints the desired character on the paper in a rolling motion similar to that of a rotary press thereby rendering a type character which is both pleasing to the eye and easier to read. This is because it does not cause the surface of the paper to be indented to the same extent as when struck with a blow from a normal type-hammer. The result, therefore, is a finished document that has an appearance more as though it were printed than typed.

Although the invention has been described in connection with an interposer which is directly operated by fluid pressure, it might be desirable to operate the interposer by means of a pressure switch. For example the output from nozzle 79 may be directed towards a pressure switch. The pressure switch can then deliver an output to a solenoid which operates the lever arm 100 in the same manner that the air pressure did in connection with the previously described embodiment.

One of the most common drawbacks of a fluid system is its sensitivity to impurities. In the above described embodiment of the invention, for example, if the typewriter is used in a contaminated atmosphere, impurities will be sucked in through opening 108 of the key 110 whenever the particular amplifier is in its neutral state. That is, when fluid flow through the mixing chamber 62 is directed into output channel 64 whereby a vacuum is pulled in control line 72. The embodiment of the invention about to be described in connection with FIG. 4, however, is adapted to prevent such contamination.

The fluid amplifier of FIG. 4 has a power input channel 12 which enters into an interaction chamber 114 for exit, when in a neutral state, through exit channel 116 and when in an activated state through exit channel 118. Two control channels 120 and 122 are connected to the mixing chamber and operated to control the direction of the amplifier's output in a manner similar to the amplifier described in connection with FIG. 2. In this case, however, the amplifier's output is switched from channel 116 to channel 118 by a positive pressure being exerted on the control channel 122 whereas the switching function in the former embodiment was accomplished by pulling a vacuum in the corresponding control channel 72. In this case the control channel 122 is connected to a pressure line 124 for common exit into a spring loaded key chamber 126 through port 128. Consequently, under normal flow conditions, i.e., when the particular character is not selected, the forces created by motion of the power

input stream past control channel 122 are counterbalanced by the forces created by motion of fluid from pressure line 124 as it passes out of port 128 thereby preventing air and debris from being sucked in through channel 122. Exit channel 118 is connected to channel 130 which corresponds in every respect to channel 77 of the embodiment described in connection with FIG. 2 and therefore will not be further described. Because the fluid amplifier presently being described operates in an inverse manner to that of FIG. 2, however, the venturi section 80 of FIG. 2 is now replaced by a flow splitting Y section 138. In this manner, the flow from the power input channel is redirected into the fluid amplifier's neutral output channel 116 shortly after timing tab 18 passes over the related detector tube 22, the exact time being determined by the lengths of the channels 120 and 132.

Having described the basic structure of the fluid amplifier of FIG. 4 its operation will now be described along with certain minor structural elements. In its neutral state the power input stream flows through the mixing chamber 114 and out of exit channel 116. At the same time, fluid in pressure line 124 exits through port 128 around a spring 140 and out through a hole 142 in housing 144 of the key chamber 126. In this manner, contaminating particles are continually blown out of the key chamber and prevented from entering the control channel 122 as they would be inclined to do in the former embodiment. When it is desired to print a character, the associated key 146 is depressed so that lower edges 148 thereof rest against the lower surface 150 of the key chamber. In this manner, the air pressure from line 124 is momentarily directed into the control channel 122 causing the power input stream to deflect into output channel 118 and exit through the related detector tube 22. When the detector tube is covered by timing tab 18 the air is redirected to a nozzle 152 from whence it exits against arm 100 whereupon the interposer 32 is inserted between the related type wheel deflector 10 and wall 36 of the typewriter housing. At this point the desired character is rolled onto the paper as previously described. As the air is diverted from channel 130 to channel 132 it is split at the Y 138 and a portion thereof directed into control channel 120. This air flow from channel 120 enters the mixing chamber 114 and forces the power input stream back into the neutral channel 116, whereupon the amplifier is immediately ready for a subsequent print cycle of the same character.

The present invention employs substantially the same type of fluid amplifiers that are designed for use in many current fluid amplifier operated devices. Hence, the typewriter structure is quite compatible for use with otherwise standard parts, thereby providing for easier maintenance and manufacture; but perhaps more importantly there are no moving linkages corresponding to those elements which the fluid amplifier has replaced.

Many of the better quality and higher speed typewriters today employ some type of proportional spacing mechanism. That is, rather than provide that subsequent characters be spaced apart, each by the same average width, the characters are spaced apart in accordance with the respective widths of the characters themselves. For example, the character "i" might only occupy two units on the printing medium, whereas the letter "m" might occupy five units on the printing medium. In proportional spacing the space between the "i" and its adjacent character, however, is the same as the distance between the letter "m" and its adjacent character. A modification of the instant invention is adapted to accomplish a proportional spacing operation and will now be described in connection with FIG. 3.

In place of the character step members on the type wheel of FIG. 1 the type wheel 154 of FIG. 3 has a series of various thickness cam surfaces 156. There is one such cam surface corresponding to each of the character elements on the type wheel. It should be under-

stood that if there are two rows of character elements on the type wheel there will be also two rows of proportional spacing cams in place of the carriage step members. The carriage step teeth 48 located in the recess 50 of FIG. 1 are replaced with an arm 158 pivoted about 160 and biased in a clockwise direction in FIG. 3 by a spring 162. Mounted on one end of the arm 164 is a pin 166 which is adapted to engage with teeth 168 of a rack 170. The teeth of the rack are relatively fine having a pitch that is a fraction of the width of the narrowest character that is to be printed. For example, if the character "i" is two units wide the pitch of the teeth on the rack might be one-half unit.

In operation, when a particular character is about to be printed the type wheel is rotated forwardly by the combined action of the rotating shaft 12 in FIG. 1, and the camming action between the type wheel deflectors 10 and the interposer 32. When this occurs, for example, with the character "m" as shown in FIG. 3, the camming surface associated with the character "m" engages the far end of the arm 158, disengaging the pin 166 from the teeth 168 of the rack 170. A driving member, not shown, tends to drive the rack at the same speed with which the periphery of the type wheel rotates. When pin 166 is removed, therefore, the rack is driven to the left in FIG. 3. As soon as the character has been printed and the type wheel is snapped back into its original position as shown in FIG. 1b the spring 162 returns the pin into engagement with the teeth of the rack and the motion of the carriage is stopped. In this manner, the carriage has been moved only an amount which is proportional to the width of the character that has been printed, thereby accomplishing one of the principles of the invention—namely a fluid operated proportional spacing typewriter.

The invention has been particularly shown and described with reference to preferred embodiments thereof. It will be understood by those skilled in the art, however, that various changes in form and details may be made therein such as replacing the raised character elements with aspirator-stencil devices or by stepping the type wheel rather than continually rotating it. It should be understood, however, that such changes would be made without departing from the spirit and scope of the invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In a typewriter of the type in which a plurality of print elements are located at fixed position about the perimeter of a rotatable type wheel and where said print elements are selectively brought into engagement with a printing medium at a printing station when the selected print element is rotated into a printing position, the combination comprising:

a fluid amplifier associated with each print element, each of said fluid amplifiers having an input channel, first and second output channels, and a control channel, and wherein said fluid normally flows from said input channel to said first output channel;

control means associated with each of said fluid amplifiers for selectively controlling pressure in the corresponding control channel so that fluid flow from said input channel is selectively directed into said second output channel;

print actuation means;

timing means for detecting the simultaneous occurrence of:

fluid flow in a selected second output channel, and the presence of the related print element in said printing position,

said timing means being operative to generate a signal indication of each said simultaneous occurrence;

and said print actuation means being operative in response to the signals generated by said timing means to move said rotatable type wheel to said print station whereby the print element associated with a se-

lected control means is brought into engagement with said printing medium.

2. In a typewriter of the type in which a plurality of print elements are located at fixed positions around the perimeter of a rotatable type wheel and where said print elements are selectively brought into engagement with a printing medium at a printing station when the selected print element is rotated into a printing position, the combination comprising:

means to rotate said type wheel;

a fluid amplifier associated with each print element, each of said fluid amplifiers having an input channel, first and second output channels, and a control channel, and wherein said fluid normally flows from said input channel to said first output channel;

control means associated with each of said fluid amplifiers for selectively controlling pressure in the corresponding control channel so that fluid flow from said input channel is selectively directed into said second output channel;

print actuation means;

means connecting said second output channel to said print actuation means;

timing means for detecting the simultaneous occurrence of:

fluid flow in selected second output channels, and the presence of related print elements in said printing position,

said timing means being operative to redirect said fluid flow from said second output channel into said connecting means and thereby to said print actuation means in response to each said simultaneous occurrence;

said print actuation means being operative in response to the redirected fluid to move said rotatable type wheel to said print station whereby the print element associated with a selected control means is brought into engagement with said printing medium.

3. In a typewriter of the type in which a plurality of print elements are located at fixed positions about the perimeter of a rotatable type wheel and where said print elements are selectively brought into engagement with a printing medium at a printing station when the selected print element is rotated into a printing position, the combination comprising:

a rotatable shaft upon which said type wheel is mounted; means to rotate said shaft;

a fluid amplifier associated with each print element, each said fluid amplifier having an input channel, first and second output channels and a control channel, wherein said fluid normally flows from said input channel to said first output channel;

control means associated with each of said amplifiers for selectively controlling pressure in the corresponding control channel so that fluid flow from said input channel is selectively directed into said second output channel;

timing means adapted to rotate in synchronism with said type wheel and further adapted to substantially block the exit of fluid from said second output channels only when a print element corresponding to a particular output channel is substantially in said printing position;

print actuation means;

connecting means for connecting each of said second output channels to said print actuation means, said timing means being operative to redirect the fluid from said second output channel into said connecting means only when said second output channel has the output thereof blocked by said rotatable timing means, said timing means thereby redirecting fluid flow to said print actuation means upon the simultaneous occurrence of:

fluid flow in the selected of said output channels, and

the presence of the related print element at said printing position;

and said print actuation means being operative in response to said redirected fluid to move said rotatable type wheel to said print station whereby the print element associated with the selected control means is brought into engagement with said printing medium.

4. In a typewriter of the type in which a plurality of print elements are located at fixed position about the perimeter of a rotatable type wheel and where said print elements are selectively brought into engagement with a printing medium at a printing station when the selected print element is rotated into a printing position, the combination comprising:

a rotatable shaft upon which said type wheel is mounted, said shaft being adapted to be flexed so that said type wheel can be moved from a printing position to said printing station;

means to rotate said shaft;

a plurality of cam surfaces on said type wheel, there being one such surface associated with each of said print elements;

a fluid amplifier associated with each print element, each of said fluid amplifiers having an input channel, first and second output channels, and a control channel, and wherein said fluid normally flows from said input channel into said first output channel;

control means associated with each of said fluid amplifiers for selectively controlling pressure in the corresponding control channel so that the flow of fluid from said input channel is switched into said second output channel;

timing means for detecting the simultaneous occurrence of:

fluid flow in the selected second output channel, and

the presence of the related print element in said printing position,

said timing means being operative to generate a signal indication of each said simultaneous occurrence;

an interposer operative in response to each said indication from said timing means to engage with the associated cam surface and urge said type wheel towards said printing station as said type wheel is rotated so that said print element associated with the selected control means is brought into engagement with said printing medium.

5. In a typewriter of the type in which a plurality of print elements are located at fixed positions about the perimeter of a rotatable type wheel and where said print elements are selectively brought into engagement with a printing medium at a printing station when the selected print element is rotated into a printing position, the combination comprising:

a rotatable shaft upon which said type wheel is mounted, said shaft being adapted to be flexed so that said type wheel can be moved from a printing position to said printing station;

means to rotate said shaft;

a plurality of cam surfaces on said type wheel, there being one such surface associated with each of said print elements;

a fluid amplifier associated with each print element, each of said fluid amplifiers having an input channel, first and second output channels, and a control channel, and wherein said fluid normally flows from said input channel into said first output channel;

control means associated with each of said fluid amplifiers for selectively controlling pressure in the corresponding control channels so that the flow of fluid from said input channel is switched into said second output channel;

timing means adapted to rotate in synchronism with said

type wheel and further adapted to substantially block the exit of fluid from said second output channel only when a print element corresponding to the particular output channel is substantially in said printing position;

print actuation means;

connecting means for connecting said second output channel to said print actuation means;

said timing means being operative to redirect the fluid flow from said second output channel into said connecting means only when said second output channel has the output thereof blocked by said rotatable timing means, said timing means thereby redirecting fluid to said print actuation means upon the simultaneous occurrence of:

fluid flow in a selected one of said second output channels, and

the presence of the related printing element at said printing station;

said print actuation means including an interposer operative in response to fluid flow from said connecting means to engage with the associated cam surface and urge said type wheel toward said printing station as said type wheel is rotated, so that said print element associated with the selected control means is brought into engagement with said printing medium.

6. In a typewriter of the type in which a plurality of print elements are located in fixed positions about the perimeter of a rotatable type wheel and where said elements are selectively brought into engagement with a printing medium at a printing station when the selected printed element is rotated into a printing position, the combination comprising:

a rotatable shaft upon which said type wheel is mounted;

means to rotate said shaft;

a carriage mechanism for holding said printing medium, said carriage mechanism being slidable relative to said type wheel shaft;

a plurality of carriage step members on said rotatable type wheel, there being a step member associated with each of said print elements;

step means on said carriage adapted to engage with said carriage step members when said type wheel is at said printing station;

a fluid amplifier associated with each print element, each of said fluid amplifiers having an input channel, first and second output channels and a control channel, and wherein said fluid normally flows from said input channel to said first output channel;

control means associated with each of said fluid amplifiers for selectively controlling pressure in the corresponding control channel so that fluid flow from said input channel is selectively directed into said second output channel;

print actuation means;

timing means for detecting the simultaneous occurrence of:

fluid flow in a selected second output channel,

and the presence of a related print element in said printing position,

said timing means being operative to generate a signal indication of each said simultaneous occurrence;

and said print actuation means being operative in response to the signals generated by said timing means to move said rotatable type wheel to said print station, the print element associated with the selected control means thereby being brought into engagement with said printing medium and said carriage step members being brought into engagement with said stepping means on said carriage, the carriage thereby being moved in the direction of rotation of said type wheel, whereby the carriage and type wheel move at

the same speed and the selected character is rolled onto said printing medium.

7. In a typewriter of the type in which a plurality of print elements are located in fixed positions about the perimeter of a rotatable type wheel and where said elements are selectively brought into engagement with a printing medium at a printing station when the selected print element is rotated into a printing position, the combination comprising:

a rotatable shaft upon which said type wheel is mounted;

means to rotate said shaft;

a carriage mechanism for holding said printing medium, said carriage mechanism being slidable relative to said type wheel shaft;

a plurality of carriage step members upon said rotatable type wheel, there being a step member associated with each of said print elements;

a step means on said carriage adapted to engage with said carriage step members when said type wheel is at said printing station;

a fluid amplifier associated with each print element each of said fluid amplifiers having an input channel, first and second output channels and a control channel, wherein said fluid normally flows from said input channel to said first output channel;

control means associated with each of said amplifiers for selectively controlling pressure in the corresponding control channels so that fluid flow from said input channel is selectively directed into said second output channel;

timing means adapted to rotate in synchronism with said type wheel and further adapted to substantially block the exit of fluid from said second output channels only when a print element corresponding to a particular output channel is substantially in said printing position;

print actuation means;

connecting means for connecting each of said second output channels to said print actuation means, said timing means being operative to redirect the fluid from said second output channel into said connecting means only when said second output channel has the output thereof blocked by said rotatable timing means, said timing means thereby redirecting fluid to said print actuation means upon the simultaneous occurrence of:

fluid flow in a selected second output channel, and the presence of a related print element in said printing position;

and said print actuation means being operative in response to said redirected fluid to move said rotatable type wheel to said print station whereby the print element associated with the selected control means is brought into engagement with said printing medium; and said carriage step members are brought into engagement with said stepping means on said carriage, the carriage thereby being moved in the direction of rotation of said type wheel whereby the carriage and type wheel move at the same speed and the selected character is rolled onto said printing medium.

8. In a typewriter of the type in which a plurality of print elements are located in fixed positions about the perimeter of a rotatable type wheel and where said elements are selectively brought into engagement with a printing medium at a printing station when the selected print element is rotated into a printing position, the combination comprising:

a rotatable shaft upon which said type wheel is mounted, said shaft being adapted to be flexed so that said type wheel can be moved from a printing position to said printing station;

means to rotate said shaft;

a plurality of cam surfaces on said type wheel, there

being one such surface associated with each of said printing elements;

a carriage mechanism for holding said printing medium, said carriage mechanism being slidable relative to said type wheel shaft;

a plurality of carriage step members on said rotatable type wheel, there being a step member associated with each of said printing elements;

step means on said carriage adapted to engage with said carriage step members when said type wheel is at said printing station;

a fluid amplifier associated with each print element, each of said fluid amplifiers having an input channel, first and second output channels, and a control channel, and wherein said fluid normally flows from said input channel into said first output channel;

control means associated with each of said fluid amplifiers for selectively controlling pressure in the corresponding control channel so that the flow of fluid from said input channel is switched into said second output channel;

timing means for detecting the simultaneous occurrence of:

fluid flow in the selected second output channel, and the presence of the related print element in said printing position,

said timing means being operative to generate a signal indication of each said simultaneous occurrence;

an interposer operative in response to each said indication from said timing means to engage with the associated cam surface and urge said type wheel towards said printing station as said type wheel is rotated so that said print element associated with the selected control means is brought into engagement with said printing medium; and said carriage step members are brought into engagement with said stepping means on said carriage, the carriage thereby being moved in the direction of rotation of said type wheel whereby the carriage and type wheel move at the same speed and the selected character is rolled onto said printing medium.

9. In a typewriter of the type in which a plurality of print elements are located at fixed positions about the perimeter of a rotatable type wheel and where said print elements are selectively brought into engagement with a printing medium at a printing station when the selected print element is rotated into a printing position, the combination comprising:

a rotatable shaft upon which said type wheel is mounted, said shaft being adapted to be flexed so that said type wheel can be moved from a printing position to said printing station;

means to rotate said shaft;

a plurality of cam surfaces on said type wheel, there being one such surface associated with each of said print elements;

a carriage mechanism for holding said printing medium, said carriage mechanism being slidable relative to said type wheel shaft;

a plurality of carriage step members on said rotatable type wheel, there being a step member associated with each of said print elements;

step means on said carriage adapted to engage with said carriage step member when said type wheel is at said printing station;

a fluid amplifier associated with each print element, each of said fluid amplifiers having an input channel, first and second output channels, and a control channel, and wherein said fluid normally flows from said input channel into said first output channel;

control means associated with each of said fluid amplifiers for selectively controlling pressure in the corre-

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sponding control channel so that the flow of fluid from said input channel is switched into said second output channel;

timing means adapted to rotate in synchronism with said type wheel and further adapted to substantially block the exit of fluid from said second output channel only when a print element corresponding to the particular output channel is substantially in said printing position;

print actuation means;

connecting means for connecting said second output channel to said print actuation means;

said timing means being operative to redirect the fluid flow from said second output channel into said connecting means only when said second output channel has the output thereof blocked by said rotatable timing means, said timing means thereby redirecting fluid flow to said print actuation means upon the simultaneous occurrence of:

fluid flow in a selected one of said second output channels,

and the presence of the related output element at said printing station;

said print actuation means including an interposer operative in response to fluid from said connecting means to engage with the associated cam surface and urge said type wheel towards said printing station as said type wheel is rotated so that the print element associated with the selected control means is brought into engagement with said printing medium and a carriage step member is brought into engagement with said stepping means on said carriage, the carriage thereby being moved in the direction of rotation of said type wheel, whereby the carriage and type wheel move at the same speed and the selected character is rolled onto said printing medium.

10. In a typewriter of the type in which a plurality of print elements are located in fixed positions about the perimeter of a rotatable type wheel and where said print elements are selectively brought into engagement with a printing medium and a printing station when the selected printing element is rotated into a printing position, the combination comprising:

a carriage mechanism for holding said printing medium, said carriage mechanism having said type print station thereon and being movable in a first direction relative to said type wheel, said first direction being the same as the direction of rotation of said type wheel;

means for moving said carriage mechanism in a second direction perpendicular to the direction of rotation of said type wheel;

said print elements adapted to have a plurality of rows of character elements thereon, said rows being aligned in the same direction as said second direction of carriage motion;

a fluid amplifier associated with each print element, each of said fluid amplifiers having an input channel, first and second output channels, and a control channel, and wherein said fluid normally flows from said input channel to said first output channel;

control means associated with each of said fluid amplifiers for selectively controlling pressure in the corresponding control channel so that fluid flow from said input channel is selectively directed into said second output channel;

said moving means being adapted to bring the carriage mechanism and thereby the print station to the level of the selected character element on the print element associated with the selected control channel;

print actuation means;

timing means for detecting the simultaneous occurrence of:

fluid flow in a selected output channel,

and the presence of the related print element at said printing station,

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said timing means being operative to generate a signal indication of each said simultaneous occurrence;

said print actuation means being operative in response to the signals generated by said timing means to move said rotatable type wheel to said print station whereby the selected character element is brought into engagement with said printing medium.

11. The apparatus of claim 10 including a ring of erasing material around the perimeter of said type wheel, said means for moving said carriage mechanism in said second direction being adapted to selectively place the printed medium at the level of said erasing material whereby an erasing function may be performed when said type wheel is moved to said printing station.

12. In a typewriter of the type in which a plurality of print elements are located in fixed positions about the perimeter of a rotatable type wheel and where said print elements are selectively brought into engagement with a printing medium at a printing station when the selected print element is rotated into a printing position, the combination comprising:

a rotatable shaft upon which said type wheel is mounted; means to rotate said shaft;

a carriage mechanism for holding said printing medium, said carriage mechanism having said print station thereon and being movable in a first direction relative to said type wheel, said first direction being the same as the direction of rotation of said type wheel;

means for moving said carriage mechanism in a second direction perpendicular to the direction of rotation of said type wheel;

said print elements having a plurality of rows of character elements thereon, said rows being aligned in the same direction as said second direction of carriage motion;

a fluid amplifier associated with each print element, each said fluid amplifier having input channel, first and second output channels and a control channel, wherein said fluid normally flows from said input channel to said first output channel;

control means associated with each of said amplifiers for selectively controlling pressure in the corresponding control channels so that fluid from said input channel is selectively directed into said second output channel;

timing means adapted to rotate in synchronism with said type wheel and further adapted to substantially block the exit of fluid from said second output channels only when a print element corresponding to a particular output channel is substantially in said printing position;

said moving means being adapted to bring the carriage mechanism and thereby the print station to the level of the selected character element on the print element associated with the selected control channel;

print actuation means;

connecting means for connecting each of said second output channels to said print actuation means, said timing means being operative to redirect the fluid flow from said second output channel into said connecting means only when said second output channel has the output thereof blocked by said rotatable timing means, thereby redirecting fluid flow to said print actuation means upon the simultaneous occurrence of:

fluid flow in a selected output channel,

and the presence of the related print element at said printing position;

and said print actuation means being operative in response to said redirected fluid flow to move said rotatable type wheel to said print station whereby a selected character element is brought into engagement with said printing medium.

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13. In a typewriter of the type in which a plurality of print elements are located in fixed positions about the perimeter of a rotatable type wheel and where said print elements are selectively brought into engagement with a printing medium at a printing station when the selected printing element is rotated into a printing position, the combination comprising:

a rotatable shaft upon which said type wheel is mounted, said shaft being adapted to be flexed so that said type wheel can be moved from a printing position to said printing station;

means to rotate said shaft;

a plurality of cam surfaces on said type wheel, there being one such surface associated with each of said print elements;

a carriage mechanism for holding said printing medium, said carriage mechanism having said print station thereon and being movable in a first direction and relative to said type wheel, said first direction being the same as the direction of rotation of said type wheel;

means for moving said carriage mechanism in a second direction perpendicular to the direction of rotation of said type wheel;

said print elements adapted to have a plurality of rows of character elements thereon, said rows being aligned in the same direction as said second direction of carriage motion;

a fluid amplifier associated with each print element, each of said fluid amplifiers having an input channel, first and second output channels, and a control channel, and wherein said fluid normally flows from said input channel to said first output channel;

control means associated with each said fluid amplifier for selectively controlling pressure in a corresponding control channel so that fluid flow from said input channel is selectively directed into said second output channel;

said moving means being adapted to bring the carriage mechanism and thereby the print station to the level of the selected character element on the print element associated with the selected control channel;

timing means for detecting the simultaneous occurrence of:

fluid flow in the selected second output channel, and the presence of the related print element in said printing position,

said timing means being operative to generate a signal indication of each said simultaneous occurrence;

an interposer operative in response to each said indication from said timing means to engage with the associated cam surface and urge said type wheel towards said printing station as said type wheel is rotated so that the selected character element on the print element associated with the selected control means is brought into engagement with said printing medium.

14. In a typewriter of the type in which a plurality of print elements are located at fixed positions about the perimeter of a rotatable type wheel and where said print elements are selectively brought into engagement with a printing medium at a printing station when the selected print element is rotated into a printing position, the combination comprising:

a rotatable shaft upon which said type wheel is mounted, said shaft being adapted to be flexed so that said type wheel can be moved from a printing position to said printing station;

means to rotate said shaft;

a plurality of cam surfaces on said type wheel, there being one such cam surface associated with each of said print elements;

a carriage mechanism for holding said printing medium, said carriage mechanism having said print station

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thereon and being movable in a first direction relative to said type wheel, said first direction being the same as the direction of rotation of said type wheel; means for moving said carriage mechanism in a second direction perpendicular to the direction of rotation of said type wheel;

said print elements adapted to have a plurality of rows of character elements thereon, said rows being aligned in the same direction as said second direction of carriage motion;

a fluid amplifier associated with each print element, each of said fluid amplifiers having an input channel, first and second output channels, and a control channel, and wherein said fluid normally flows from said input channel to said first output channel;

control means associated with each of said fluid amplifiers for selectively controlling pressure in the corresponding control channel so that fluid flow from said input channel is selectively directed into said second output channel;

said moving means being adapted to bring the carriage mechanism and thereby the print station to the level of the selected character element on the print element associated with the selected control channel;

timing means adapted to rotate in synchronism with said type wheel and further adapted to substantially block the exit of fluid from said second output channel only when a print element corresponding to the particular output channel is substantially in said printing position;

print actuation means;

connecting means for connecting said second output channel to said print actuation means;

said timing means being operative to redirect the fluid flow from said second output channel into said connecting means only when said second output channel has the output thereof blocked by said rotatable timing means, said timing means thereby redirecting fluid flow to said print actuation means upon the simultaneous occurrence of:

fluid flow in a selected one of said second output channels,

and the presence of the related printing element at said printing station;

said print actuation means including an interposer operative in response to fluid from said connecting means to engage with the associated cam surface and urge said type wheel towards said printing station as said type wheel is rotated, so that the selected character element on the print element associated with the selected control means is brought into engagement with said printing medium.

15. In a typewriter of the type in which a plurality of print elements are located at fixed positions about the perimeter of a rotatable type wheel and where said print elements are selectively brought into engagement with a printing medium at a printing station when the selected printing element is rotated into a printing position, the combination comprising:

a rotatable shaft upon which said type wheel is mounted; a means to rotate said shaft;

a carriage mechanism for holding said printing medium, said carriage mechanism having said printing station thereon and being movable in a first direction relative to said type wheel shaft, said first direction being the same as the direction of rotation of said type wheel;

means for moving said carriage mechanism in a second direction perpendicular to the direction of rotation of said type wheel;

said print elements adapted to have plurality of rows of character elements thereon, said rows being aligned in the same direction as said second direction of carriage motion;

a plurality of carriage step members on said rotatable

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type wheel, there being a step member associated with each of said print elements;
 step means on said carriage adapted to engage with said carriage step members when said type wheel is at said printing station;
 a fluid amplifier associated with each print element, each of said fluid amplifiers have an input channel, first and second output channels, and a control channel, and wherein said fluid normally flows from said input channel to said first output channel;
 control means associated with each of said fluid amplifiers for selectively controlling pressure in the corresponding control channel so that fluid flow from said input channel is selectively directed into said second output channel;
 said moving means being adapted to bring the carriage mechanism and thereby the print station to the level of the selected character element on the print element associated with the selected control channel;
 print actuation means;
 timing means for detecting the simultaneous occurrence of:

fluid flow in a selected second output channel;
 and the presence of a related print element in said printing position,
 said timing means being operative to generate a signal indication of each said simultaneous occurrence;

and said print actuation means being operative in response to the signals generated by said timing means to move said rotatable type wheel to said print station, the selected character element on the print element associated with the selected control means thereby being brought into engagement with said printing medium and said carriage step members being brought into engagement with said stepping means on said carriage, the carriage thereby being moved in the direction of rotation of said type wheel, whereby the carriage and type wheel move at the same speed and the selected character is rolled onto said printing medium.

16. In a typewriter of the type in which a plurality of print elements are located in fixed positions about the perimeter of a rotatable type wheel and where said print elements are selectively brought into engagement with a printing medium at a printing station when the selected print element is rotated into a printing position, the combination comprising:

means to rotate said type wheel;

a fluid amplifier associated with each print element, each of said fluid amplifiers having an input channel, first and second output channels, and first and second control channels, and wherein said fluid normally flows from said input channel to said first output channel;

control means associated with each of said fluid amplifiers for selectively controlling the pressure in the first control channel so that fluid from said input channel is selectively switched into said second output channel;

timing means for detecting the simultaneous occurrence of:

fluid flow in each selected second fluid output channel;

and the presence of the related print element in said printing position,

said timing means being operative to generate a signal indication of each said simultaneous occurrence;

said print actuation means being operative in response to the signals generated by said timing means to move said rotatable type wheel into said printing position at said print station whereby the print element associated with the selected control means is brought into engagement with said printing medium;

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and means operative in response to said signals generated by said timing means for controlling fluid pressure in said second control channel so that fluid flow from said input channel is redirected into said first output channel.

17. In a typewriter of the type in which a plurality of print elements are located at fixed positions about the perimeter of a rotatable type wheel and where said print elements are selectively brought into engagement with a printing medium at a printing station when the selected print element is rotated into a printing position, the combination comprising:

means to rotate said type wheel;

a fluid amplifier associated with each print element, each of said fluid amplifiers having an input channel, first and second output channels, and a control channel, and wherein said fluid normally flows from said input channel to said first output channel;

said second output channel having primary and secondary exit channels and adapted so that fluid flowing in said second output channel tends to flow out of said primary exit channel;

control means associated with each of said fluid amplifiers for selectively controlling pressure in the corresponding control channel so that fluid flow from said input channel is directed into said second output channel;

print actuation means connected to said secondary exit channel of said second output channel;

timing means operating in synchronism with said type wheel and adapted to substantially block the exit of fluid from said primary exit and redirect said fluid into said secondary exit, and thereby to said print actuation means, when the selected print element is rotated into said printing position;

said print actuation means being operative in response to the fluid from said secondary exit to move said rotatable type wheel into said printing position at said print station whereby the print element associated with the selected control means is brought into engagement with said printing medium.

18. The apparatus of claim 17 including a second control channel operative in response to the flow of fluid in said secondary exit channel to switch the fluid flow from said input channel back into said first output channel.

19. The apparatus of claim 18 wherein said second control channel has an input end and a control end;

and said secondary exit channel has a flow restriction therein, said input end of said second control channel being connected to said flow restriction, flow of fluid in said secondary exit channel thereby causing a drop in the pressure at the control end of said second control channel whereby fluid is switched from said input channel back into said first output channel.

20. A typewriter of the type in which a plurality of print elements are located in fixed positions about the perimeter of a rotatable type wheel and where said print elements are selectively brought into engagement with a printing medium at a printing station when the selected print element is rotated into a printing position, the combination comprising:

a fluid amplifier associated with each printing element, each of said fluid amplifiers having an input channel, first and second output channels, a control channel having an input end and a control end, and wherein said fluid normally flows from said input channel to said first output channel;

pressure means connected to the input end of said control channel so that the fluid flow from said pressure means tends to exit from said input end of said control channel;

means for selectively blocking the input end of said control channel thereby directing the fluid flow from said pressure means into the control end of said control

channel so that the fluid flow in said input channel switches to said second output channel;

print actuation means;

timing means for detecting the simultaneous occurrence of:

- fluid flow in a selected output channel,
- and the presence of the related print element in said printing position,
- said timing means being operative to generate a signal indication of each said simultaneous occurrence;

and print actuation means being operative in response to the signals generated by said timing means to move said rotatable type wheel to said print station whereby the print element associated with the selected control means is brought into engagement with said printing medium.

21. In a typewriter of the type in which a plurality of print elements are located at fixed positions about the perimeter of a rotatable type wheel and where said print elements are selectively brought into engagement with a printing medium at a printing station when the selected print element is rotated into a printing position, the combination comprising:

- means to rotate said type wheel;
- a fluid amplifier associated with each print element, each of said fluid amplifiers having an input channel, first and second output channels, and a control channel having an input end and a control end, and wherein said fluid normally flows from said input channel to said first output channel;

pressure means connected to the input end of said control channel so that fluid flow from said pressure means tends to exit from said input end;

control means for selectively blocking the input of said control channel thereby directing the pressure into said control end so that the fluid flow from said input channel switches into said second output channel;

said second output channel having primary and secondary exit channels and adapted so that fluid flowing in said second output channel tends to flow out of said primary exit;

print actuation means connected to said secondary exit channel of said second output channel;

timing means operating in synchronism with said type wheel and adapted to substantially block the exit of fluid from said primary exit channel and redirect the flow into said secondary exit channel, and thereby to said print actuation means, when the selected print element is rotated into said printing position;

said print actuation means being operative in response to the fluid flow from said secondary exit channel to move said rotatable type wheel into said printing position at said print station whereby the print element associated with the selected control means is brought into engagement with said printing medium.

22. The apparatus of claim 21 including a second control channel operative in response to the flow of fluid in said secondary exit channel to switch the fluid flow from said input channel back into said first output channel.

23. The apparatus of claim 21 wherein said secondary exit channel has a flow divider therein, one portion of the divided fluid being directed to said print actuation means and the other portion of said divided fluid being delivered to the input end of said second control channel, whereby the flow of fluid in said secondary exit channel causes a rise in pressure at the control end of said second control channel whereby fluid flow is switched from said input channel back into said first output channel.

24. In a typewriter of the type in which a plurality of print elements, each having one or more character elements thereon, are located at fixed positions about the perimeter of a rotatable type wheel and where said print elements are selectively brought into engagement with a printing medium at a printing station when the selected print element is rotated into a printing position, and wherein the character elements on the various print elements have varying widths, the combination comprising:

- a fluid amplifier associated with each print element, each of said fluid amplifiers having an input channel, first and second output channels, and a control channel, and wherein said fluid normally flows from said input channel through said first output channel;
- control means associated with each of said fluid amplifiers for selectively controlling pressure in the corresponding control channel so that fluid from said input channel is selectively directed into said second output channel;

print actuation means;

timing means for detecting the simultaneous occurrence of:

- fluid flow in a selected output channel,
- and the presence of the related print element in said printing position,
- said timing means being operative to generate a signal indication of said simultaneous occurrence;

said print actuation means being operative in response to the signals generated by said timing means to move said rotatable type wheel to said print station whereby the print element associated with a selected control means is brought into engagement with the said printing medium;

and means for moving said printing medium with respect to said type wheel each time that a character is printed thereon, wheel moving means being adapted to move the printed medium only an amount proportional to the width of the printed character.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,315,775

April 25, 1967

Arnold Schonfeld

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 10, line 74, for "said output" read -- said second output --; column 12, line 32, for "printed" read -- print --; column 13, line 54, for "seelcted" read -- selected --; column 15, line 45, for "said type print" read -- said print --; column 16, line 36, for "secnod" read -- second --; column 21, line 35, for "input of" read -- input end of --; line 49, for "flow into" read -- fluid flow into --; column 22, line 23, for "selected output" read -- selected second output --.

Signed and sealed this 28th day of November 1967.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents