C. N. Van Avery

The IBM SELECTRIC Composer

Memory Backspace

Abstract: This paper describes the design of the memory backspace system as it now appears in the IBM SELECTRIC Composer. The memory backspace system employs a sensing pawl mechanism in conjunction with the escapement pinwheel and the unit backspace mechanism to provide character-by-character backspace capability. By sensing set pins on the pinwheel, the mechanism "remembers" the location of previously typed characters and permits the carrier to be returned precisely to any print position within the memory "length" without operator measurement or visual alignment.

Introduction

It was recognized early in the design program of the IBM SELECTRIC Composer that, due to the proportional escapement system suggested, backspacing (returning the carrier and printing element to an exact prior print position) would require some form of "memory" control, which would permit the operator to backspace precisely to any desired position without referring to escapement charts, counting backspace units, and/or close visual checking. This problem could apparently be solved by a mechanism which, when tripped by the operator, would activate the repeat backspace mode until a predetermined stopping position had been reached. A mechanically controlled and activated mechanism, completely self-contained, was indicated.

The approach selected was to design a mechanism to operate with the proposed escapement system, utilizing the pinwheel of that system for the memory and a modified backspace drive mechanism. The objective could only be met, however, if certain restrictions were placed on the design itself.

The carrier could be driven rearward only in one-unit increments; hence, all sensing would have to be accomplished within one unit of pinwheel rotation. The sequence of events in the activation of the memory backspace, the drive mechanism, and the sensing device was required to be serial. Since the proportional escapement system was an essential part of the Composer, the memory backspace system would have to operate so as not to adversely affect the escapement system. Thus, the desired speeds, operating times, operating tolerances, displacement requirements, and geometry of the memory backspace system and its parts depended not only on its internal operation, but on many fixed outside factors as well. Among the parameters that could not be altered were the space between pins in the escapement pinwheel, the pinwheel displacement for each backspace cycle, the operating speed of the machine, and the location, geometry, and mounting location of the other mechanisms in the system.

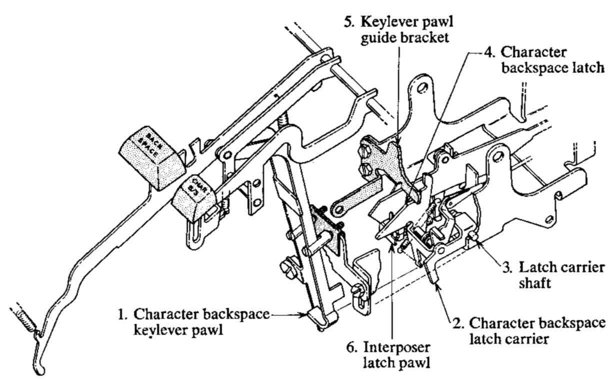

Figure 1 Front portion of backspace mechanism, showing character and unit backspace keylevers, latch and pawls.

The standard IBM SELECTRIC and Model C Typewriters use characters of equal width and there is thus no need for realignment in backspacing. The Model C EXECUTIVE Typewriter, because of its proportional spacing, has a backspace unit of less than one character width, and backspacing accuracy relies wholly on the operator, who must depend on visual alignment and auxiliary devices to locate prior print points.

The composer backspace system is driven by the same backspace drive mechanism as that of the standard SELECTRIC Typewriter, slightly modified to fit the Composer's

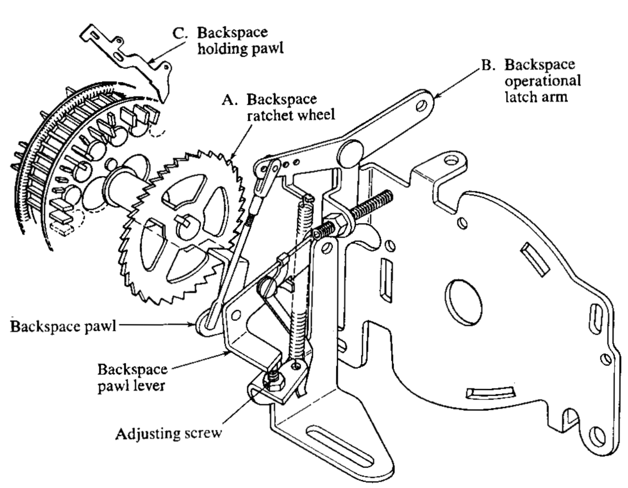

Figure 2 Modified portion of backspace drive mechanism.

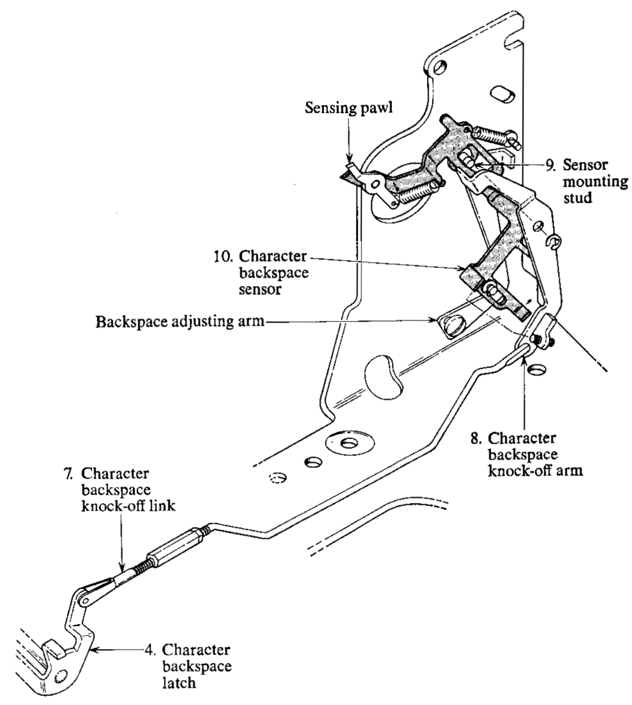

Figure 3 Sensing portion of mechanism and linkage connecting the activation and knockoff portions.

functional requirements. The IBM SELECTRIC Typewriter, Model C Typewriter, Model C EXECUTIVE Typewriter and SELECTRIC Composer all use pawl and rack mechanisms to drive the carrier in the backspace direction.

The SELECTRIC Composer's rack takes the form of a ratchet wheel connected to the escapement system, and rather than doubling as a stop for the forward escapement (as in the other machines), it is totally disconnected from the escapement system except during the backspace operation. This enables the SELECTRIC Composer to backspace, as in the other machines, but goes one step beyond: it is capable, without operator assistance, of stopping exactly at any prior print point within its "memory" range. The "memory" range is determined by the number of available pins in the pinwheel and the unit value of the letter escapements in one full revolution of the pinwheel. Since the number of pins in the pinwheel is fixed at sixty, and character escapements (widths) can range from three to nine units, the effective "memory" range is 60/9, six characters, to 60/3, twenty characters. The "memory" length is independent of character type size and machine pitch setting.

Solution adopted

Interaction with the entire escapement system, the keyboard, the interlock system, the backspace drive system, and the homing operation of the carrier return and tab machine functions, dictated the geometry of the parts, their inter-related motions, their location, the tolerances which had to be held, and the provisions that had to be made for proper mechanism adjustment. The limitations were quite severe and, with the exception of the interlock system and some keyboard parts, could not be compromised for the memory backspace function. Because of the memory backspace system the operational scheme of the backspace drive mechanism had to be modified without changing its functional characteristics. The backspace drive pawl had to be clear of the ratchet as soon as the backspace drive operation had been completed, to prevent possible mechanical seizure due to simultaneous operation of the escapement and memory backspace mechanisms.

The mechanism consists of four main sections: the keylever which receives operator input; the mechanism which initiates and sustains the repeat backspace mode; the sensing portion which signals the appropriate stopping point in relation to the escapement function; and a suitable linkage to connect the separate sections to make a completely closed mechanical circuit.

The mechanisms which receive the operator input and initiate and sustain the repeat backspace mode are illustrated in Fig. 1.

The backspace interposer was modified to accept inputs from both the single and repeat backspace keylevers, while the remainder of the mechanism arrangements, i.e., clutch release arm, clutch pawls, latches, etc. are standard SELECTRIC Typewriter machine parts.

The drive portion of the backspace system is shown in Fig. 2. It differs from the standard SELECTRIC Typewriter mechanism by having a pawl and ratchet arrangement instead of a pawl and rack.

Figure 3 illustrates the sensing portion of the character backspace and the linkage which connects the input and sensing mechanism together.

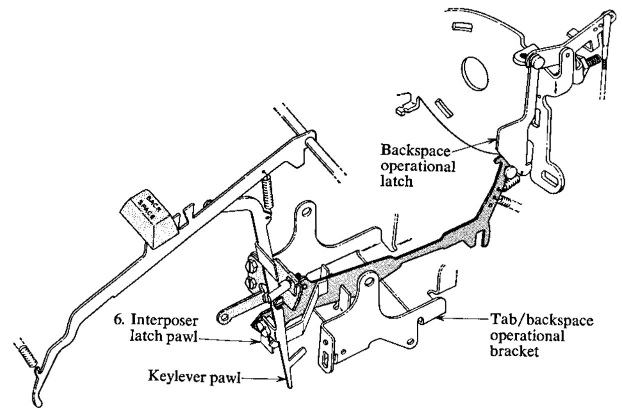

Figure 4 Input, activation mechanism and part of drive mechanism as oriented in machine (front of machine to left).

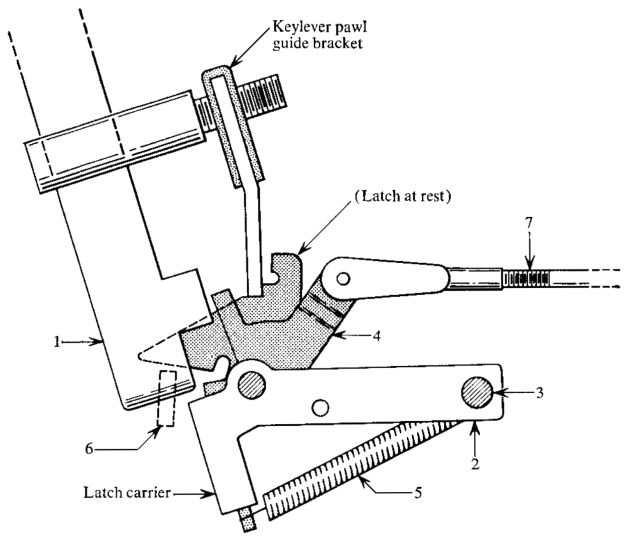

Figure 5 Character backspace latch at rest.

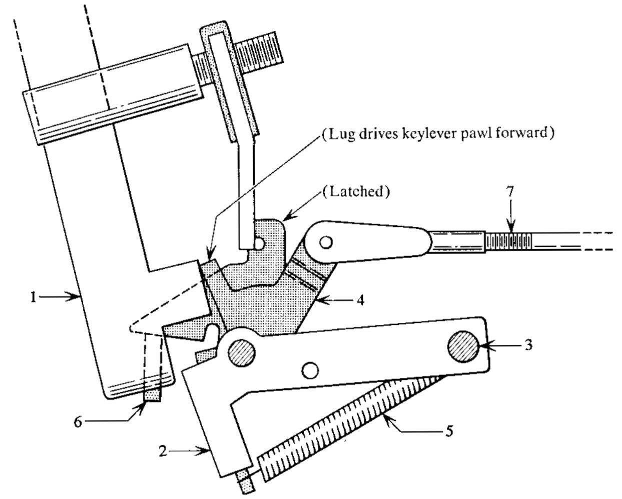

Figure 6 Character backspace latch rotated to trip position (note forward position of keylever pawl).

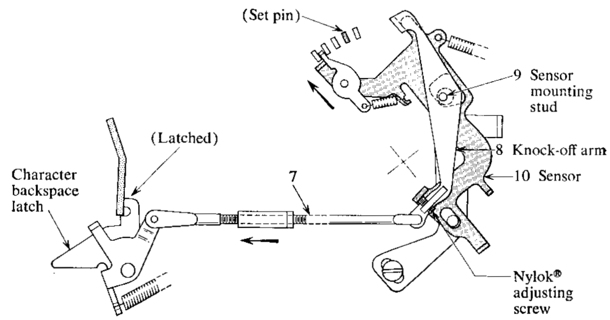

Figure 7 Character backspace mechanism in sensing position.

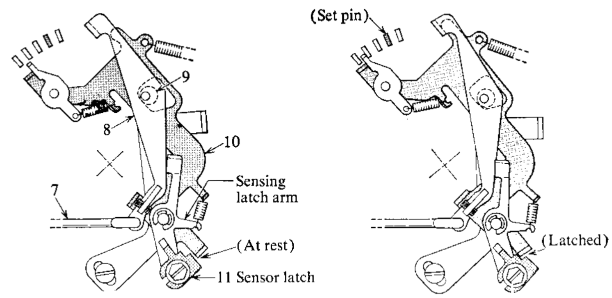

Figure 8 Backspace sensor (*a*) at rest; (*b*) activated by rear latch.

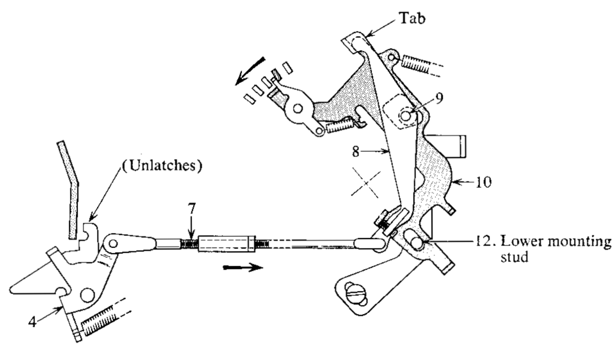

Figure 9 Sensor catching set pin and completing cycle.

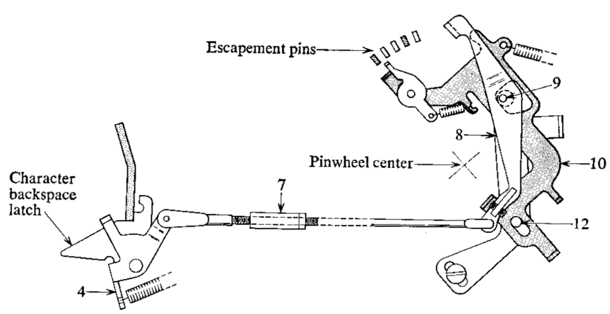

Figure 10 Character backspace latch in unlatched position and sensor at rest at end of cycle.

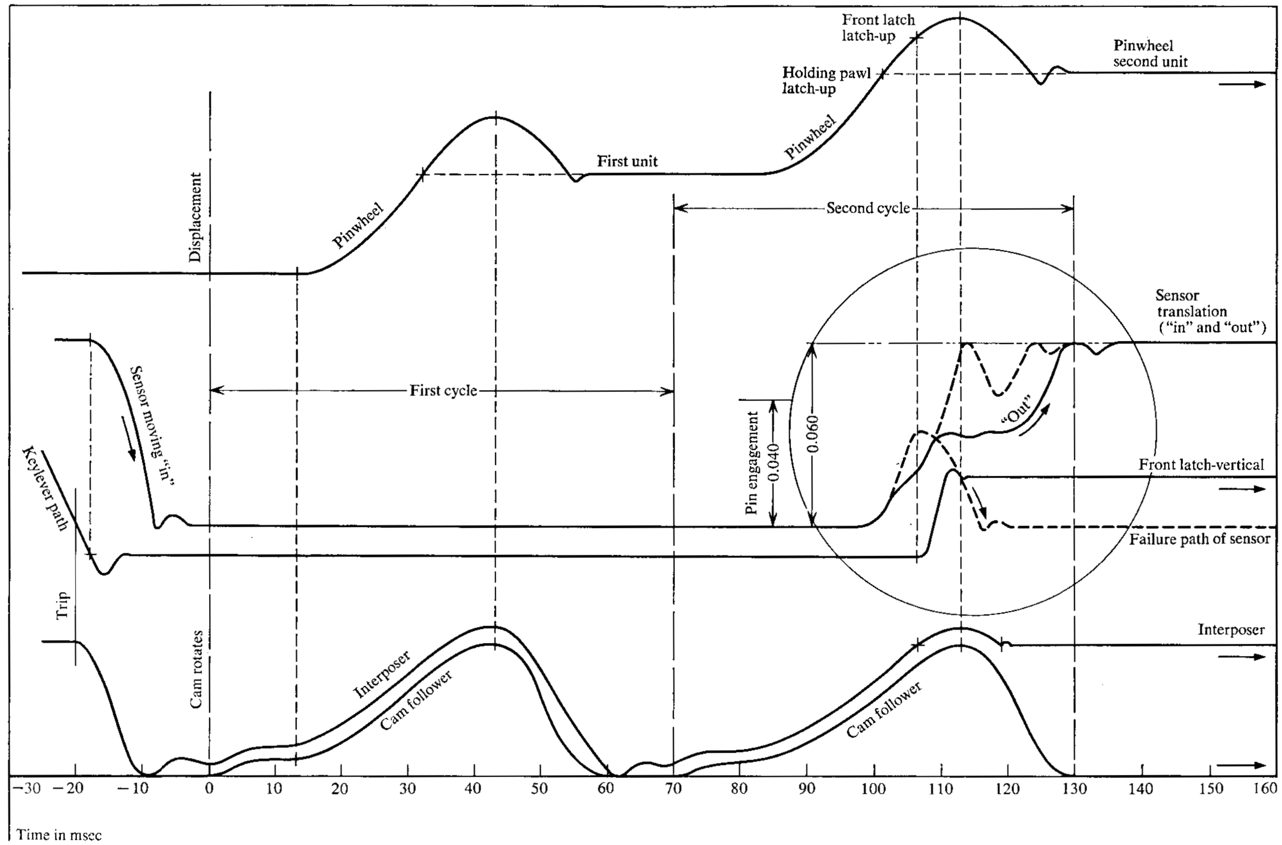

Figure 11 Timing diagram for two units of memory backspace.

Figure 4 shows the general arrangement in the machine of the portions of the entire mechanism which are shown in Figs. 1 and 2.

The sequence of operation of the character backspace mechanism is illustrated in Figs. 5 through 9 and described as follows:

When the character backspace keylever is depressed, the character backspace keylever pawl (1) rotates the latch carrier (2) around its pivot point (3) in a counterclockwise direction. As the latch carrier moves downward it carries the character backspace latch (4) to a point where it can swing counterclockwise under the action of latch spring (5), to the latched position shown in Fig. 6. The rotation of the character backspace latch accomplishes three functions simultaneously: (a) it trips the operational interposer by tripping the operational interposer latch (6), (b) it drives the keylever pawl forward to prevent operator interference with machine function, and (c) it pulls the character backspace link (7) which rotates the knock-off arm (8) around the sensor mounting stud (9) and slides the sensor (10) into sensing position in the pinwheel. When the sensor is in its sensing position the sensor latch (11) swings into place to insure that the sensor stays in position in the pinwheel until its function is accomplished.

Meanwhile the tripped operational interposer pushes the backspace latch under the cam follower and activates the backspace clutch. As the cam rotates the cam follower pulls down on the operational latch which, in turn, pulls on a link in the backspace drive mechanism (see Fig. 2), pulling the backspace pawl into the ratchet wheel and imparting motion to the pinwheel in the backspace direction. The backspace drive mechanism repeats the cycle until the sensing pawl picks up a set pin (Fig. 9). The sensor is rotated in the backspace direction around the lower mounting stud (12) picking up the tab on the knockoff arm (8) and rotating the knockoff arm around the sensor mounting stud (9) in the counterclockwise direction. This motion pulls the link (7) and rotates the character backspace latch (4) clockwise to its at-rest position. When the character backspace latch is at rest, the sensor latch (11) allows the sensor (10) to come out of the pinwheel. Rotating the character backspace latch to the at-rest position allows the operational interposer to latch up and the repeat backspace operation stops (Fig. 10). This completes the cycle. Figure 11 shows a timing diagram for two units of operation. (In memory backspace mode, of course, the system will normally repeat its cycle for at least three units, since this is the minimum character width.)

Each character backspace keybutton signal will cause the system to cycle until the next set pin on the pinwheel is detected by the sensing mechanism. The operation can be repeated character-by-character until the pinwheel has completed one revolution; this represents the maximum memory "length" and is equal to 60 escapement units. The number of characters and spaces stored will vary according to character width from six (all 9-unit characters) to twenty (all 3-unit characters).

Testing

During the testing program, which included life-testing of components and full instrumentation of the mechanism, it became evident that several changes were desirable to insure the reliability of the mechanism. To guarantee the absolute serial operation of the entire system, a finer adjusting method had to be devised. This was accomplished by adding a turnbuckle to the link connecting the two main portions of the mechanism. Also, it was discovered that the machine occasionally missed the expected prior print point because the sensor would sometimes slip out of the pinwheel before the repeat backspace mode had stopped. A latch was added to the pinwheel box portion of the mechanism to insure that the sensor stayed in the pinwheel until the instant required for operation.

Two limitations (neither severe from an operational standpoint, however) are noted: In the first case, it was found that the memory backspace system would locate a prior character-print position but would not always locate the left-hand margin or a tab stop after the escapement system had moved the carrier away from them. The reason for this is that the memory backspace mechanism philosophy is based on backspacing to a set pin. Since there is no provision in the machine to set a pin at the left-hand margin or at any set tab stops, it is possible for the backspace to pass by a set tab stop, and the left-hand margin if no set pin is encountered. The only requirement imposed by this limitation, however, is that the operator remember it. Both the left margin and any set tab stops can be located for error correction by using the carrier-return, no-index function (described elsewhere), followed (for tab stops) by a normal forward-tab key operation.

The second is one of accuracy. After returning to a print location via the memory backspace, the operator might discover that the strikeover is not exact. This is because the carrier is being driven backwards on the same leadscrew that allows it to escape. Friction forces and manufacturing tolerances allow the carrier and the print element to be a few thousandths off immediately after backspacing. It is possible to remove these effects by backspacing past the required position and then escaping, thus putting the carrier shoe bias in the same direction for the overstrike as for the initial print. This limitation is not considered detrimental because the slight misalignment has no effect on other operations and is easily operator correctable. No machine changes were deemed necessary.

Conclusions

The memory backspace, as it exists in the IBM SELECTRIC Composer, achieves its basic objective. It is possible to relocate the carrier and printing element at a prior print point as long as the print point remains in the "memory" of the system. The method used allowed the mechanism to become a part of the total system in such a way that none of the other mechanisms directly included was detrimentally affected.

Acknowledgment

Acknowledgement is due to Mr. G. A. Holt for significant contributions to the design described above.

Received March 16, 1967.