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The IBM SELECTRIC Composer

Type Font Compatibility

Abstract: Because of the large number of type fonts required to support the IBM SELECTRIC Composer program, it would not have been economical to manufacture separate type elements for each country in which the machine would be marketed. Also, because the total of the standard alphanumeric characters and the typical basic language requirements for all countries is much greater than could possibly be fitted on the Composer's 88-position type element, special Composer fonts had to be developed for various language group classifications. This paper describes the SELECTRIC Composer's development from a single-language system to a multilingual concept and details the problems involved in achieving compatibility, and thus type font interchangeability.

Introduction

• *Need for type font compatibility*

Special orthographic symbols have been developed for almost all the basic languages in the world to indicate phonetic or semantic values and to symbolize the residual influences of ancient writing or printing techniques. A typical illustration of the latter is the German ß sign, which is a combination of the Gothic "s" (ſ) and "z" (ȝ). This symbol is still very much in use for "sz" or "ss" combinations in Germanic printing. Diacritical marks are employed to distinguish letters or sounds which resemble each other to indicate their pronounciation, as é, à, ü, ñ, î, ç. These marks are frequently used in the Latin languages—French, Spanish, Portuguese, Italian—and those of the Germanic and Nordic peoples.

In addition to these basic language requirements, the printing industries in the various European countries have developed needs for symbols that differ from each other, i.e., currency signs; punctuation, quotation, and reference marks; and fractions. Because the total of the standard alphanumeric characters and the typical basic language requirements of all countries is much greater than could possibly be fitted on the SELECTRIC Composer's 88-position type element, special Composer fonts had to be developed for various language group classifications.

• *Needs in terms of the mechanism*

Since today's communication and transportation systems practically obliterate boundary lines, we tend to make less distinction in the language needs of any one particular geographic location. For this reason a multilingual concept was favored for the SELECTRIC Composer. It was therefore proposed that type fonts (which are unique in themselves for any given language) should be made compatible, and thus interchangeable, with all other language type fonts.

At first approach, the multilingual concept was partially adopted by locating the characters which all languages have in common in identical positions on each type element with the exception of the question mark, exclamation point and colon, whose location varies due to keyboard needs of the individual country. These characters were: upper- and lowercase of the alphabetics; the numerals, period, comma, parentheses, diagonal, ampersand, and dash. The remainder of the characters were positioned to comply with basic character usage and placement philosophy.[1] Design and horizontal escapement allocations were made according to the best judgment of the type designers.

The result of this was that the characters which are common for each type font were entirely interchangeable on all machines; but an escapement and print velocity incompatibility was encountered in the other characters and symbols. These were the very characters for which the type font interchangeability was needed most. This incompatibility was engendered by the fact that the number of escapement units assigned to the "noncommon" characters varied on each of the national type fonts. This could result, for example, in a seven-unit character of a domestic (American) type font obtaining a five-unit escapement on a Germanic machine; whereas the five-unit character of a Germanic type

font obtains the seven-unit escapement on a domestic machine. This effect could be resolved by a manual correction, e.g. the operator could add a two-unit space to a five-unit escapement to print a seven-unit domestic character with a Germanic machine. An additional problem, however, was that the variable spacebar mechanism could not be used for that purpose because that would destroy the justifier readings and settings, resulting in an unjustified line.

A character selection in the no-print mode is the only other possible way to space forward without print action. A prerequisite for this method is that the operator know the unit escapement assigned to each character—something that is not required for any other Composer operation. Also, it is not possible to escape less than three units in the forward direction. For a correction of less than three units, a three-unit no-print forward space had to be applied in combination with one or two backspace operations. This procedure makes the interchangeability of type fonts possible, but results in frequent incompatibility with tremendous inconvenience and loss of efficiency.

Print velocity incompatibility (e.g., where a low print velocity required for a Nordic type font obtained a high print velocity on a domestic Composer, thus embossing the character on the copy) creates similar problems to that of escapement incompatibility; however, there was no way for the operator to correct this problem.

Design specifications

• *Operational objectives*

The principal objectives were defined as (1) standardization of the arrangement of escapement values for all type fonts; (2) minimization of the frequency of print velocity incompatibility; and (3) correction of the effects of print velocity incompatibility.

The concept of typehead layout,[1] as outlined previously, has been the basis and guideline for the relocation of the "noncommon" characters of the basic national machines.

Some of the problems which limited the degree of compatibility of the type fonts were:

(a) The number of characters of each possible escapement was different for each font; e.g., a Domestic type element contained many more 8-unit characters than were required on a type element for the Latin Composer.

(b) The Latin speaking countries have need for a nonescapement function (the so called dead key) to enable the operator to place diacritical marks over characters, without a character backspace operation.

• *Final specifications*

Considering the large number of fonts per country required to support the Composer program, it would not have been economical to manufacture separate type elements for each country in which the machine would be marketed. To minimize the number of fonts, product planning established the following four major classifications:

Domestic (American)
Nordic
Germanic
Latin

(Type elements for the United Kingdom are modified domestic elements, where the $ sign is replaced by a £ sign.) The characters established for basic national fonts are compromises of the most frequently required characters and symbols of the related language groups.

The final arrangement of characters for all elements was not determined at the start of the procedure but was developed during the transition period as a common denominator for escapement requirements.

The character location at the keyboard does not play an important role in a character and escapement type font compatibility program; instead the selector interposers located under the keylevers are the media which "program" the machine during a print operation to obtain the type element position corresponding to the selected keybutton. If a character changes position on the type element but not on the keyboard arrangement, a different selector interposer is required to accomplish correct printing. This system can be best described by a block diagram, as shown by Fig. 1.

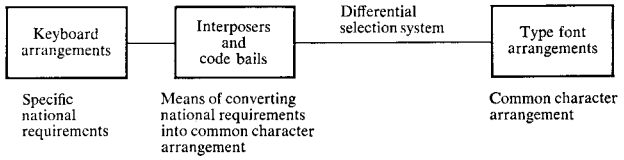


Figure 1 Block diagram of scheme for converting character selection signals at the keyboard (where character location arrangements vary according to language) to print signals at the type element (where the character arrangement is fixed).

A unique feature of the IBM SELECTRIC Typewriter is that the complete keyboard arrangement may be changed without affecting the typehead layout (or the reverse), providing that the upper-and-lowercase positions are not separated. This possibility has been used for the French-Latin and Germanic Composers.

French typists are used to an alphabetic keyboard arrangement where the characters on the left side of the second row form the combination "AZERTY" instead of the "QWERTY" arrangement found on English typewriters. The French-Latin Composer therefore has a different interposer and code bail schedule than the Latin Composer but both use exactly the same Latin type elements. A similar situation of code bails and interposers exists for the Germanic machine, to comply with the German standard

"QWERTZ." The following national keyboard arrangements will be used:

Domestic
United Kingdom
Nordic
Germanic
Latin
French-Latin

Diacritical marks require a nonescapement function of the print carrier. This, of course, is required only if Latin fonts are used, because other fonts do not have separate diacritical marks. However, machines equipped with this so-called dead key mechanism[2] presented a major compatibility problem because this function is fixed in the machine and manual escapement correction as discussed previously is inconvenient and time-consuming. The solution was achieved in two steps:

(1) The dead key character selector interposers were "programmed" to the escapement values of the corresponding type font locations of the other national fonts.
(2) The dead key function was provided with a disconnecting device[2]. The action of this mechanism was intended to disconnect the dead key function, which would allow the print carrier to advance the number of escapement units "programmed" by the selector interposer.

Since the dead key function is not a basic requirement in the Domestic, Germanic, and Nordic SELECTRIC Composers, it is not standard equipment. The Latin diacritical marks may be made on these machines with a character backspace function between the accent and the required vowel. Where Latin elements are used frequently, a dead key function would be found useful and would add to the versatility of the system; it can be included, therefore, when desired.

There is, obviously, a correlation between the size (face area) escapement assignment and the print velocity of a character; hence, a better escapement compatibility will generally also improve the print velocity compatibility. There are a number of situations, however, when the two contradict each other. Under these circumstances, escapement compatibility will take priority over print velocity compatibility, because a mechanical print velocity adjustment device can be designed more easily than an escapement correction device, and it is easier for an operator to perform a print velocity correction than to perform an escapement correction. Also, a print velocity incompatibility (especially between high and medium velocity) is not as readily recognized. The effect may decrease somewhat in photographic reproduction and may therefore be less noticeable, whereas an escapement incompatibility remains clearly visible with no possibility of correction after copy leaves the Composer.

Attempted solutions

The first effort to improve the character and escapement compatibility on the type fonts was combined with the establishment of a standard interposer schedule for all machines (Fig. 1). This had many engineering and manufacturing advantages; however, specific national keyboard requirements could not be met with this method and the approach had to be rejected.

The second effort was to improve character and escapement compatibility and, at the same time, concentrate all "noncommon" characters (22 per font) on three slides* of the type font mold. With this approach, an enormous advantage could be obtained in manufacturing the Nordic, Germanic, and Latin type fonts. Eight common slides in one mold would reduce engraving time for these fonts by 73%. This approach, however, interfered in some instances with the basic character location philosophy[1] and could result in bad print quality.

Adopted solutions

The key to the solution of the compatibility problem was a comparison chart giving a tabular presentation of the four basic national type font arrangements (Fig. 2). All the selection positions of the type element were placed in one horizontal line, and the upper and lowercase characters were shown with their escapement and print velocity assignments. The four fonts were placed in such a way that the corresponding locations formed a vertical row. From here the process of moving characters from one place to another began. Three different procedures were established:
(1) Relocation on the type element of the various nationally dependent (noncommon) characters either with, or without, a change in keyboard arrangement. This step involved moving the characters to a location where their escapement assignments would be similar to that of other fonts. This accounted for an improvement in the escapement compatibility level from approximately 80% (the starting condition) to about 88%.
(2) Redesign of some of the nationally indigenous characters to comply with the more frequently used escapement values. This step involved reassignment of escapement values and redesign of some of the characters. The problem was that a relatively large number of wide characters in the domestic arrangement did not appear in other language fonts. Characters like @, $\frac{1}{2}$, $\frac{1}{4}$, $\frac{3}{4}$ were therefore reduced from nine units to eight units to comply with some of the eight-unit characters of Nordic and Germanic fonts which had been increased from seven units for the same reason, e.g., Ä and Å. (Later, eight-unit escapement assignments were adopted for all uppercase A's on all type fonts.) By integrating the second step with the first, the escapement compatibility could be improved up to about 95%.

* A slide is one of the engraved "type dies" that form the shell of the mold used to form a type element (typehead).

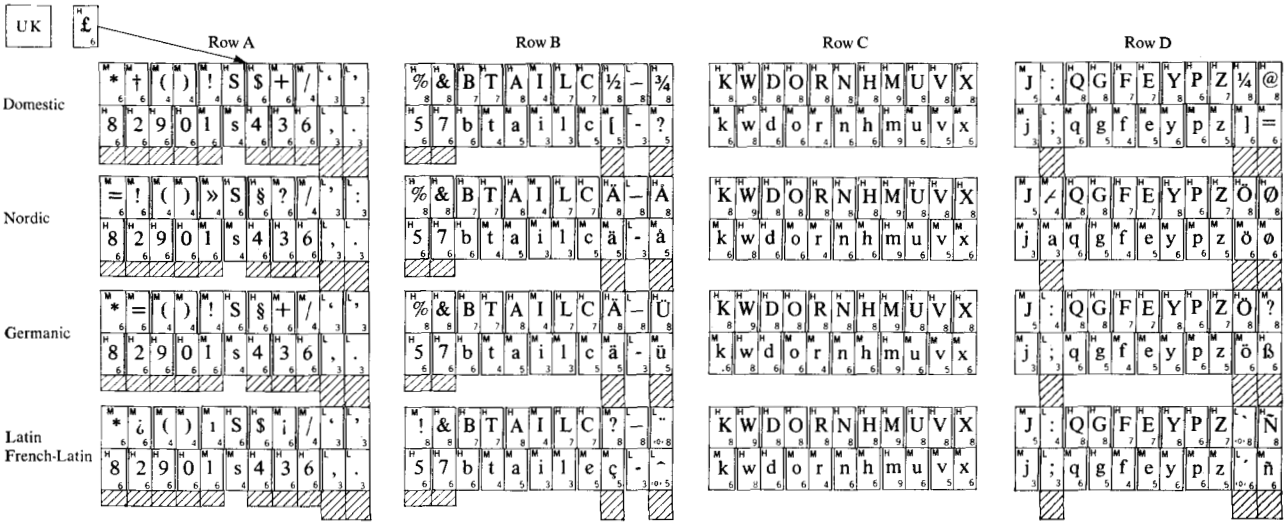
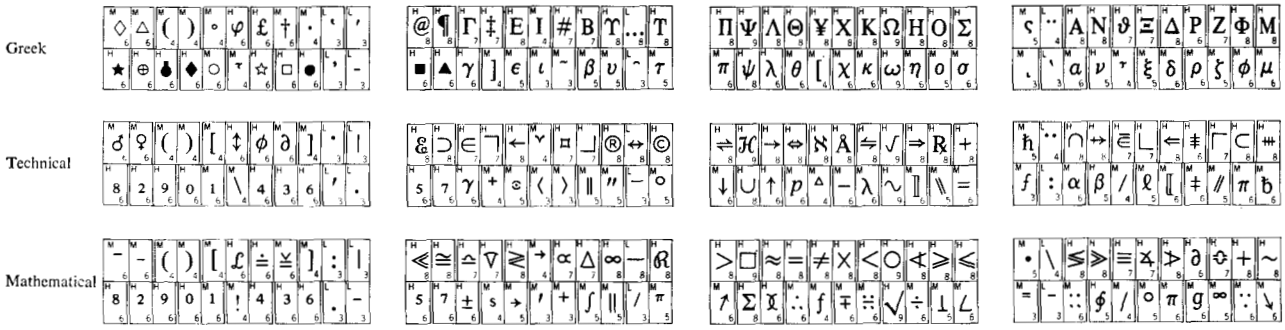


Figure 2 The four basic national type font arrangements (as placed on the type element).

Figure 3 Three special type fonts (as placed on the type element).



(3) Reassignment of some of the nationally indigenous characters to other escapement values. The characters ? ! were major reassignments (3 units); and ¿ ¡ ;] were minor reassignments (1 unit). This last step, aimed at reaching 100% compatibility, involved reassignment of the escapement values of some characters without redesigning or affecting the positions of these characters on the type element; e.g., the exclamation and question marks of the Latin machines designed for five-unit escapements were assigned eight-unit escapements by adding a three-unit quad space behind the character. This quad space might show slightly at the end of a justified line, but the frequency of such a situation is quite low—about two or three times in every 1000 lines for the question mark and even less for the exclamation mark. It is possible for the operator to compensate for this on the SELECTRIC Composer with a backspace operation.

The reader will understand that these three processes were much integrated; a change in the second or third step very often necessitated changes in the first step, in order to obtain ultimate compatibility.

The second operational objective—minimization of the frequency of print velocity incompatibilities—was realized automatically by the standardization process described above.

The third objective—correction of the effects of residual print velocity incompatibility—could not be achieved by character rearrangement but had to be solved mechanically within the Composer itself. To enable the operator to obtain the print velocity required for a character of a "foreign" type font the Composer can be equipped with a print velocity control mechanism. This manual velocity control gives the operator the ability to change the print velocity to a high, medium, or low impact.

Final design

- *Type fonts*

Figure 2 is a tabular illustration of the final type element design of the four language groups.

With the aid of this chart (Fig. 2) one may readily determine from the corresponding locations in the vertical

rows which character to select on one keyboard to obtain the needed character of one of the other type fonts.

In addition to the four language groups, special fonts were designed for use in scientific and technical work. The typehead layout for these was arranged so that the escapement and velocity assignments for each character or symbol would be compatible with those of the standard alphanumeric elements. The arrangement is shown in Fig. 3. By referring to this chart and to Fig. 2, the keyboard location for the desired symbol or character can be determined.

• *Keyboards*

As mentioned previously, the keyboard arrangements are independent of the typehead arrangements; hence, for the same standard alphabetic typehead layout, domestic, United Kingdom, Nordic, and Latin machines have a "QWERTY" arrangement; Germanic has a "QWERTZ" arrangement, and French-Latin an "AZERTY" arrangement. All countries use their own alphanumeric arrangement to print alphanumeric characters from other type fonts. Figure 4 shows these keyboard arrangements.

• *Escapement compatibility*

There are no escapement corrections necessary for Germanic or Latin type fonts during text typing, with the possible exception of an infrequent question or exclamation mark occurring at the end of a justified line or before quotation marks.

• *Print velocity control function*

The print velocity could not be made completely compatible without also jeopardizing escapement compatibility. To obtain the correct print velocity when any other than the basic national font is used, a manual velocity control dial can be provided at the left-hand side of the Composer keyboard (an optional feature). This dial will select the high, medium, or low print velocity on a character-by-character basis and is spring loaded to an automatic position to return to the print velocity coding system for the basic national font.

• *Dead key function*

The compatibility problem related to the dead key function has been solved by assigning escapement values to the dead key selector interposers; the carrier can now escape through a distance equal to the assigned value whenever escapement is permitted by the dead key disconnect device.

During a dead key operation the pin set and clear mechanisms[3] function normally; however, the rotation of the pinwheel, and thus the escapement of the print carrier, is prevented because the escapement trip lever is not actuated by the escapement cam follower. The dead key disconnect "cripples" the dead key action, permitting the trip lever to move, the pinwheel to rotate, and the print carrier to escape the "pre-programmed" escapement value. For countries other than the Latin countries, the dead key and dead key disconnect features have a conveniently useful application if Latin fonts are used frequently.

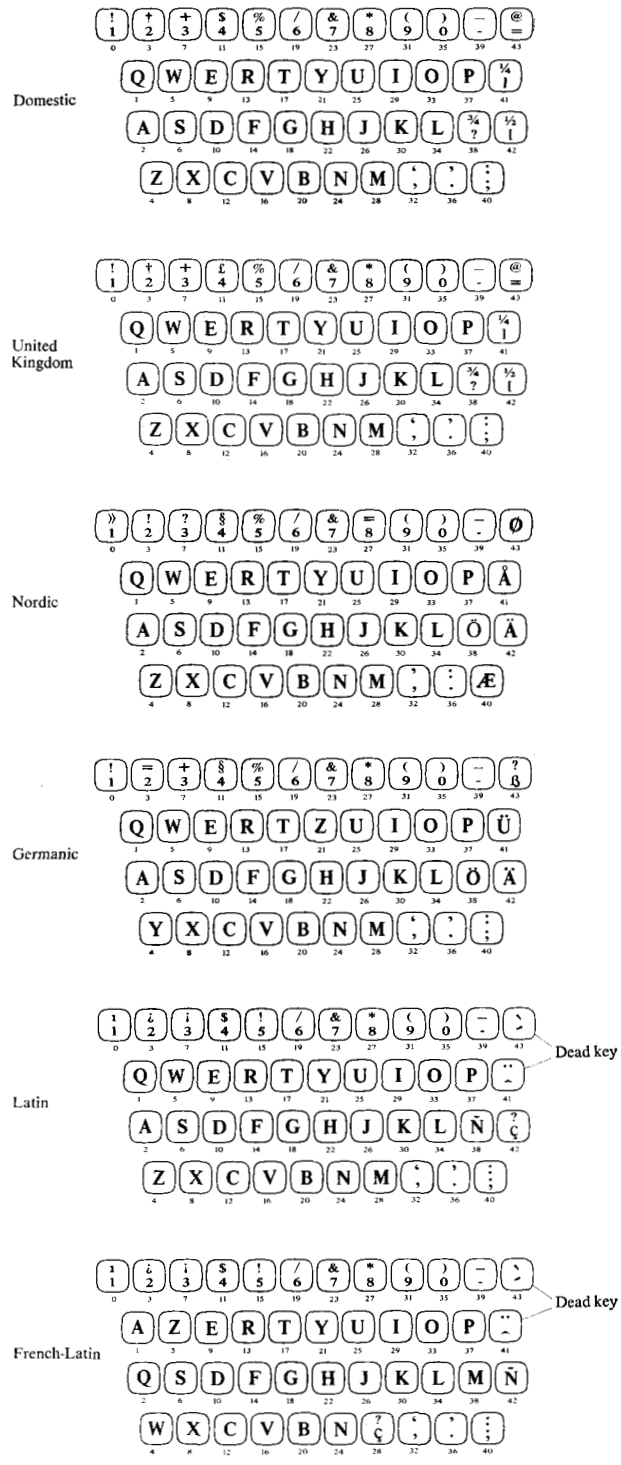


Figure 4 The six basic keyboard arrangements.

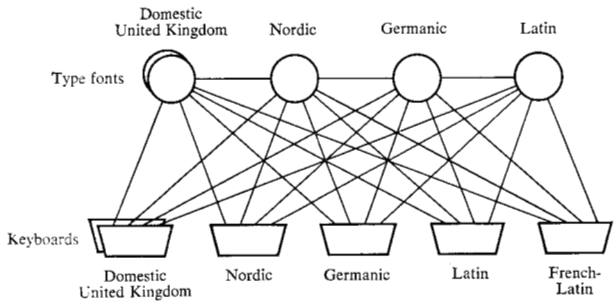


Figure 5 Illustration of multilingual compatibility. Note that type fonts (type elements) are interchangeable but that keyboards (machines) are not.

Conclusions

Escapement compatibility, as conceived in the final design, expands the application of the SELECTRIC Composer from a single language to a multilingual concept. In combination with the velocity control and the dead key disconnect, other languages may be printed with almost the same facility as the basic language of the particular machine used. Escapement compatibility applies to type fonts that are interchangeable for all countries marketing the SELECTRIC Composer. Escapement compatibility does not apply to machines or keyboards. In other words, type fonts are interchangeable for multilingual applications but machines are not. The versatility of the multilingual concept is illustrated in Fig. 5.

There are two important consequences of the multilingual concept with respect to the future development of the Composer: (1) New type element arrangements that contain new, nationally indigenous characters with new escapement values must comply with the established standardized escapement system. (2) Keyboard flexibility is a specific feature of the SELECTRIC Typewriter, as well as the SELECTRIC Composer; however, the present design of the velocity control scheme limits this flexibility of keyboard arrangements somewhat with respect to the locations of low print velocity characters such as the comma, period, colon, semicolon, quotation marks and accent marks. These characters cannot be placed in many other locations on the present keyboards; therefore, any new keyboard arrangements should retain these characters in their present positions. However, they may be interchanged within these limitations.

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