June 14, 1960 S. KHALIL 2,940,575

TYPING MACHINES FOR ARABIC GROUP LANGUAGES

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	Name	Independent	Final	Medial	Initial	Added
1	alif	ا	ا			ا
2	bā	ب	ـب	ـبـ	بـ	
3	tā	ت	ـت	ـتـ	تـ	
4	thā	ث	ـث	ـثـ	ثـ	
5	jīm	ج	ـج	ـجـ	جـ	
6	ḥā	ح	ـح	ـحـ	حـ	
7	kha	خ	ـخ	ـخـ	خـ	
8	dāl	د	ـد			د
9	dhāl	ذ	ـذ			ذ
10	rā	ر	ـر			ر
11	zā	ز	ـز			ز
12	sīn	س	ـس	ـسـ	سـ	
13	shīn	ش	ـش	ـشـ	شـ	
14	ṣād	ص	ـص	ـصـ	صـ	
15	ḍād	ض	ـض	ـضـ	ضـ	
16	ṭā	ط	ـط	ـطـ	طـ	
17	ẓā	ظ	ـظ	ـظـ	ظـ	
18	ʿain	ع	ـع	ـعـ	عـ	
19	ghain	غ	ـغ	ـغـ	غـ	
20	fā	ف	ـف	ـفـ	فـ	
21	ḳāf	ق	ـق	ـقـ	قـ	
22	kāf	ك	ـك	ـكـ	كـ	
23	lām	ل	ـل	ـلـ	لـ	
24	mīm	م	ـم	ـمـ	مـ	
25	nūn	ن	ـن	ـنـ	نـ	
26	hā	ه	ـه	ـهـ	هـ	
27	waw	و	ـو			و
28	yā	ى	ـى	ـيـ	يـ	
		Terminal			Preterminal	

Fig.1

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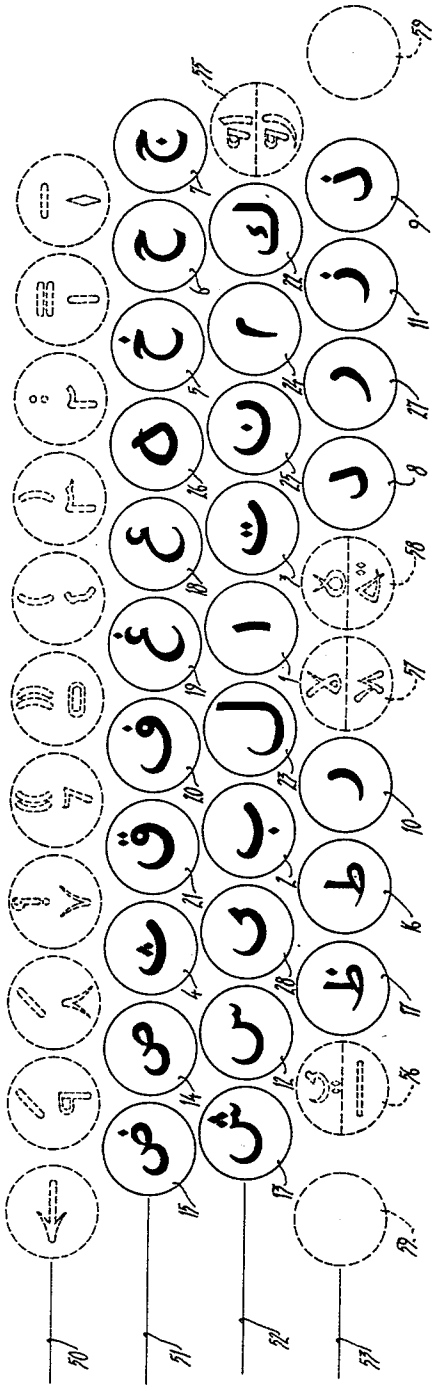

Fig. 2

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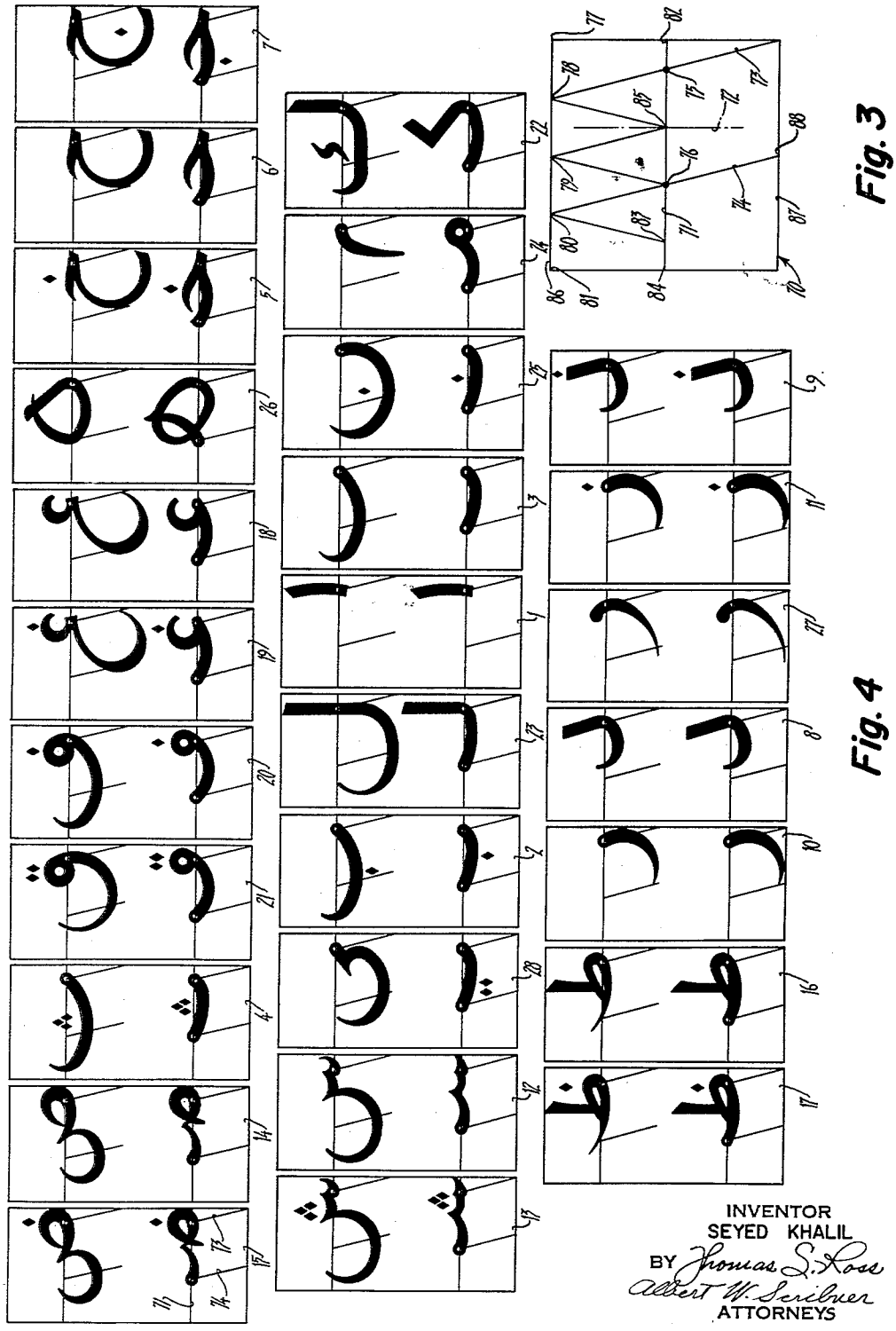

Fig. 3

Fig. 4

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TYPING MACHINES FOR ARABIC GROUP LANGUAGES

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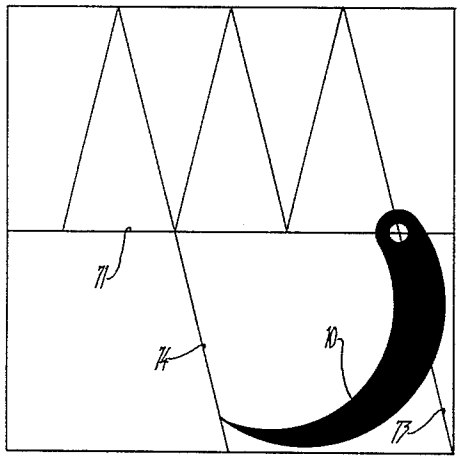

Fig. 5

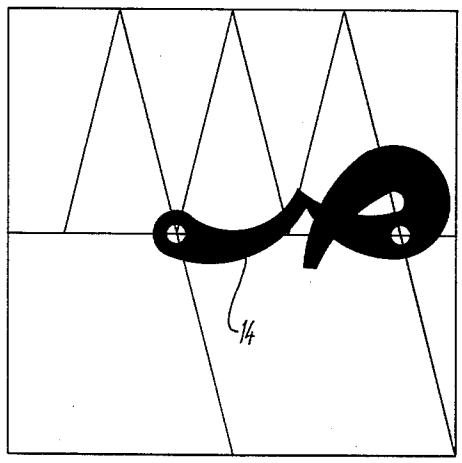

Fig. 6

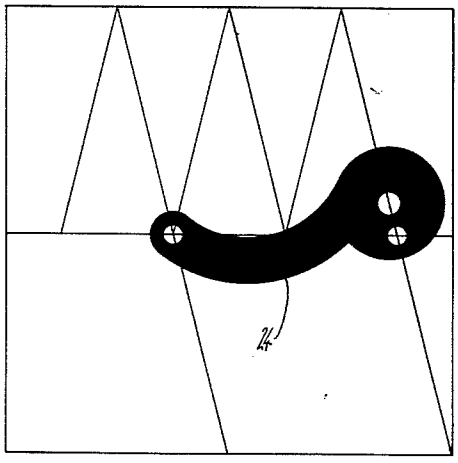

Fig. 7

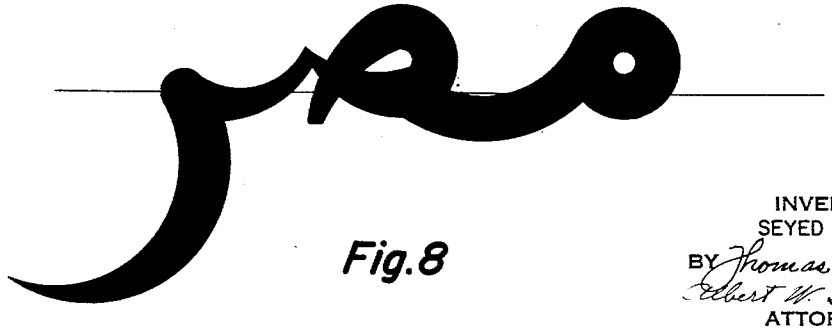

Fig. 8

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TYPING MACHINES FOR ARABIC GROUP LANGUAGES

Filed Dec. 19, 1957 6 Sheets-Sheet 5

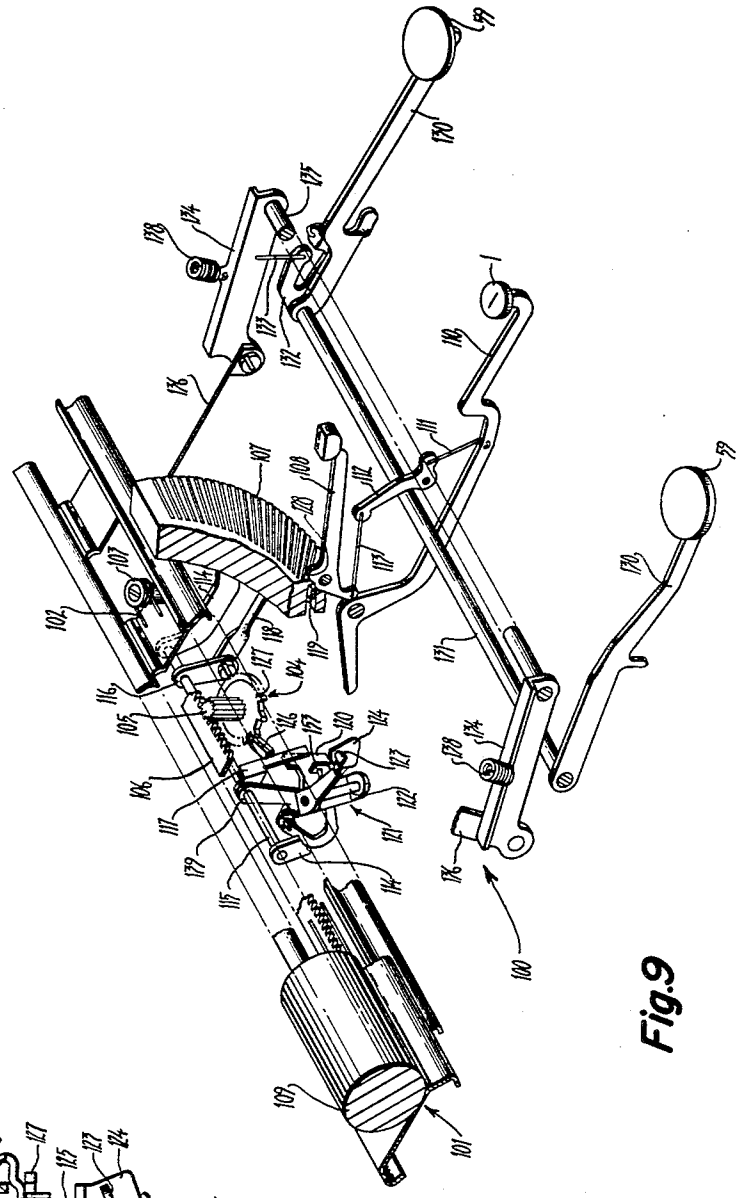

Fig. 9

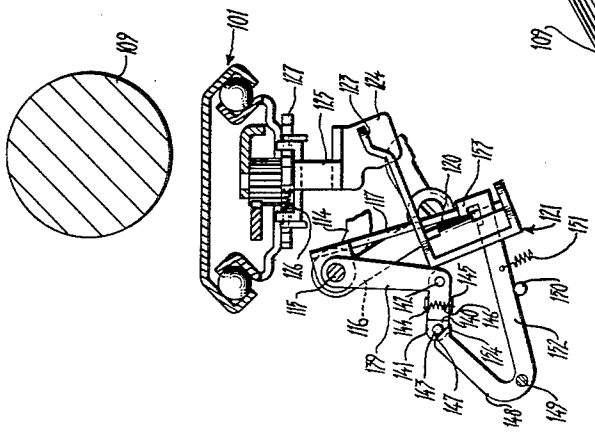

Fig. 10

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TYPING MACHINES FOR ARABIC GROUP LANGUAGES

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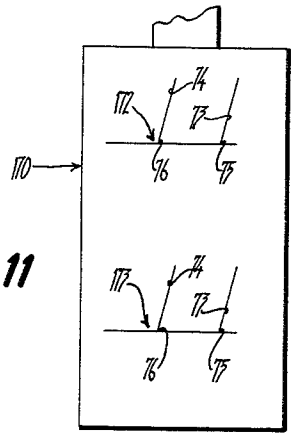


Fig. 11

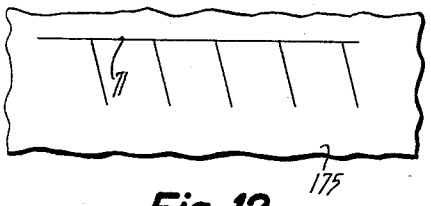


Fig. 12

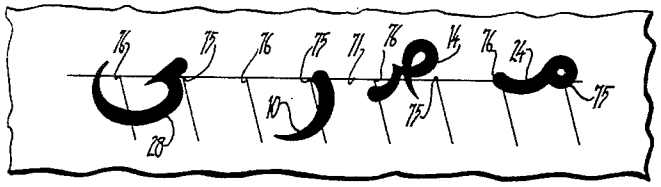
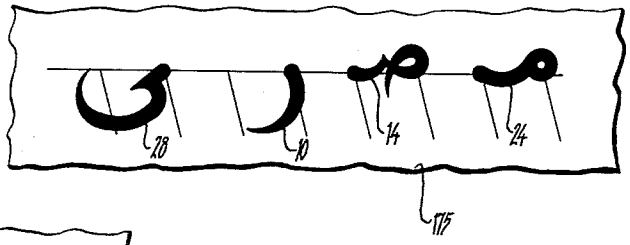


Fig. 13

Fig. 14



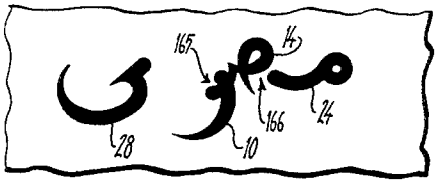
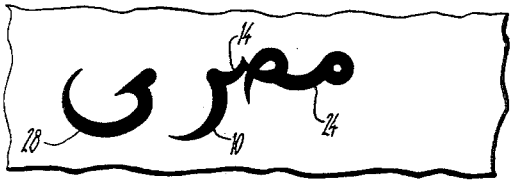


Fig. 15

Fig. 16



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2,940,575

TYPING MACHINES FOR ARABIC GROUP LANGUAGES

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Filed Dec. 19, 1957, Ser. No. 703,850

16 Claims. (Cl. 197—1)

This invention relates to a new and improved system and apparatus for typing Arabic characters.

In its traditional forms the Arabic language is very difficult to learn, read and write. The many idiosyncrasies of the language have made it very difficult to produce a practical Arabic typewriter which is capable of operating at speeds and efficiencies comparable to that of English typewriters. The several characteristics of the language which have heretofore caused the greatest difficulty in typewriter design and construction will be briefly discussed.

First, the large number of different Arabic characters has required the incorporation of a correspondingly large number of keys, type bars and related linkages in conventional Arabic typewriters. Each of the letters of the Arabic alphabet may have as many as four different forms. These four are called the independent, initial, medial or final forms respectively, and are used where a given letter stands alone, or is the first, one of the middle, or the last letter, respectively, of any particular word. The number of different letter forms or characters used total more than one hundred.

Secondly, when writing in Arabic the successive letters of a word are constructed from right to left and each of said letters is, in most cases, connected to the next following letter as in English handwriting so as to form a continuous series of characters. In that there is no distinction between Arabic handwriting and printing, it will be apparent that successively typed letters of an Arabic word should be similarly interconnected, where possible, so as to form a continuous series of characters.

Thirdly, the relative widths of the many Arabic characters vary greatly; for example, the independent form of the letter sad may be many times as wide as any form of the letter alif. It will be apparent that if successively typed Arabic letters of varying effective widths are to be interconnected as above described, some sort of mechanism must be provided for permitting a variable escapement of the typewriter carriage as the latter is successively letter spaced.

Fourthly, the above noted interconnection required between the successively typed Arabic letters presents a critical problem of type bar alignment during the manufacture and/or repair of Arabic typewriters.

In order to accommodate these characteristics of the Arabic language conventional typewriters have been provided with various complex and costly mechanisms such as proportional spacing mechanisms, "silent" keys, special keys etc. These structural features however have greatly increased the initial and maintenance costs of the machine and in some cases have not resulted in any substantial increase in the operational speed of the typewriter. Several proposals have been made to reduce the number of letter forms used in the Arabic alphabet, however these proposals have left unsolved the resultant increased criticality of type bar alignment and the problem of properly interconnecting the successively typed characters.

The instant invention overcomes these and other disadvantages of conventional Arabic typewriters by providing a "two form" system of Arabic characters wherein each character is standardized as to shape, size and relative position. The present invention contemplates the application of this system of characters to a portable typewriter in a manner that will permit a direct, rapid and efficient typing of said characters.

One object of the instant invention is to provide an improved system for typing Arabic characters.

Another object of the instant invention is to provide an improved alphabetical system of Arabic letters whereby all of the letters of the alphabet have two standardized forms.

Another object of the invention is to provide a system of junctions between successively typed characters.

Another object of the invention is to provide a standardized shape, position, and size for each letter of the Arabic alphabet whereby typing of the Arabic language will be greatly facilitated.

Another object of the invention is to provide a simple inexpensive Arabic typewriter wherein no selection between several letter keys is necessary when different forms of any given one of the various Arabic letters are to be typed and wherein no proportional spacing mechanism is required.

Another object of the invention is to provide an improved Arabic typewriter having a uniform carriage escapement mechanism and wherein the type for all of the characters of one letter form are located on the type bars in positions which respectively correspond to that of the lower case type of an English typewriter, and wherein the type for all of the characters of the other letter form are located on said type bars in positions which respectively correspond to that of the upper case type of an English typewriter.

Another object of the invention is to provide a simple, fast acting and very inexpensive Arabic typewriter which requires neither a variable escapement mechanism, "silent" keys nor a conventional type space bar.

A further object of the invention is to provide a novel method and apparatus for aligning the type bars of a typewriter.

Still another object of the invention is to provide an Arabic typewriter with a uniform carriage escapement which may be actuated in response to the operation of the case shift linkage of said typewriter.

Other objects of the invention will become apparent as the disclosure progresses.

In the drawings:

Fig. 1 shows the various initial, medial, final and independent forms of the letters of the present Arabic language, and also illustrates the system of characters contemplated by the instant invention.

Fig. 2 is a plan view showing the keyboard arrangement of the instant typewriter.

Fig. 3 is a diagrammatic view showing a letter gage for determining the sizes, shapes and positions of the type on the typewriter type blocks.

Fig. 4 is a diagrammatic view showing the shapes, sizes and relative positions of the various characters of Fig. 2.

Figs. 5–8 are diagrammatic views illustrating the proper interconnection of three successively typed Arabic letters.

Fig. 9 is a perspective view showing the principal parts of a portable Arabic typewriter which is constructed in accordance with the instant invention.

Fig. 10 is a detailed side elevational view partly in section showing a portion of the apparatus of Fig. 9.

Figs. 11–16 are diagrammatic views illustrating the method and apparatus for aligning the various type bars of the instant typewriter.

Although the present disclosure will be made with reference to the Arabic language, it will be understood that the principles discussed herein may be applied to other languages in the Arabic group, such as Persian or Urdu.

Fig. 1 shows the various independent, final, medial and initial forms for the twenty eight letters regularly used in the Arabic language. The respective alphabetically listed letters alif through yā have been numbered 1–28 inclusive. As mentioned above, the independent form of a letter is used when the letter stands alone as in one-letter English words such as "a" and "I." The final, medial, and initial forms of a letter are respectively used when that letter is the last, one of the middle or the first letter of an Arabic word. It should be borne in mind that Arabic words are constructed from letters which are written and read from right to left and that where possible each successive letter is connected to the next following letter. It will be noted from Fig. 1 that in many cases the medial form of a letter e.g. jīm, letter number 5) is very similar to the initial form of the same letter except that the medial form has a junction line (such as at 30) which properly belongs to the end of the preceding letter. Obviously no junction line, such as 30, is needed by the initial letter forms in that there are no preceding letters to be connected to the first or initial letter of a word. In similar fashion it will be noted that in most cases the final form of a letter, for example kāf, letter number 22, is very similar to the independent form of the same letter except that the final form has a junction line, such as at 31, which properly belongs on the end of the next preceding letter in the word. Obviously the independent form of a letter does not need a junction line such as at 31 in that this form of a letter stands alone and is not connected to any other letters. The six letters numbered 1, 8–11 and 27 are not connected to the next following letters of a word.

Conventional Arabic typewriters may require two or more separate keys and type bars in order to type a particular form of a given letter and/or may require two or more different keys to respectively print the different forms of a letter. Likewise variable carriage escapement mechanisms and "silent" keys (i.e. keys whose actuation will produce a printed figure on the record paper but will not actuate the carriage escapement mechanism) are respectively provided in said conventional machines in order to accommodate characters of varying widths, such as alif and dād numbered 1 and 15, and to provide a means for manually controlling and printing the desired number of dots (or similar devices) adjacent the various forms of letters such as bā, tā and thā, numbered 2–4 of Fig. 1. It will be apparent that where any initial or medial letter form is to be connected to the junction line such as 30 or 31 of the next following character the type bars of the machine must not only be aligned but the type for each of said initial and medial characters must be designed so as to make such interconnection possible. Thus any Arabic typewriter which is designed and constructed to accommodate all these features of the Arabic alphabet will of necessity be either too expensive to manufacture or too slow in operation as compared with conventional English typewriters.

The present invention contemplates the utilization of a system having only two forms for each of the twenty eight Arabic letters, these two forms being hereinafter respectively referred to as the terminal and the preterminal forms; and the incorporation of this system of terminal and preterminal letter forms in an Arabic typewriter in such a way that visually pleasing printed words may be properly typed in a rapid, clear and inexpensive manner.

As denoted in Fig. 1 the terminal letter forms or characters for each of the letters alif through yā are respectively the same as the said independent letter forms. The preterminal forms or characters for each of the letters

numbered 2—7, 12—26 and 28 are respectively the same as the said initial letter forms. The six letters numbered 1, 8–11 and 27 have no distinctive medial and initial forms, hence the predeterminal characters for these six letters are defined by the six added characters as shown in Fig. 1. It will be noted that these added preterminal letter forms are substantially the same as the respective terminal forms for these same letters. The last letter of an Arabic word and a letter standing alone will always be written in the terminal form while all the letters before said last letter of a word will each be written in the preterminal form. By properly designing each of the preterminal characters, so that it is extended to properly connect to the next succeeding letter, the necessity for junction lines, similar to that shown at 30 and 31 of Fig. 1, will be obviated. This type of construction for each of the characters must, however, be such that a consistently accurate interconnection between the successively typed characters is possible, otherwise the typed word will not always be comprehensible.

Prior attempts have been made to reduce the number of Arabic letter forms used in connection with a typewriter, e.g. see U.S. Patents 1,403,329 and 1,686,627. Such proposals however have not been entirely satisfactory either because the cost of the machine has not been decreased, the speed of operation has been low, or the successively typed characters could not be relatively aligned as consistently and accurately as is required when using less than the usual four letter forms.

Fig. 2 shows the instant system of terminal and preterminal alphabetical letter forms as applied to a portable Arabic typewriter. The typewriter keyboard of Fig. 2, comprises four rows of keys 50, 51, 52 and 53. The dotted lined keys in the upper row 50 define the usual numerical and punctuation keys, the numerical type being disposed in the lower case positions and the type for the punctuation marks being disposed in the upper case positions. The three lower rows 51, 52 and 53 contain the keys for the twenty eight letters of the Arabic alphabet. These twenty eight keys are shown in solid line and are marked with the terminal forms of the letters respectively associated therewith. The nature and use of the characters respectively shown on the four dotted lined keys 55, 56, 57 and 58 in rows 52 and 53 are well known in the Arabic language and need not be explained here. The two dotted lined keys 59 in row 53 designate the usual carriage or segment "shift" keys of the typewriter. The numbering of the keys in Fig. 2 corresponds to the letter numbering of Fig. 1.

By providing two and only two letter forms, terminal and preterminal, for each of the twenty eight letters of the Arabic alphabet, the operative disposition of the two sets of type for respectively printing the said two letter forms may respectively correspond to that of the upper and lower case type of an English typewriter. Thus the preterminal characters may be typed by merely sequentially depressing the various desired letter keys shown in Fig. 2 while the terminal characters may be typed by operating the shift key 59 and then depressing the desired letter key. By employing the said disposition of type in the typewriter, each of the letters of the Arabic alphabet is associated with one and only one key of the typewriter keyboard. Hence a typist will never find it necessary to decide which one of two or three letter keys to depress when any particular letter or letter form is to be typed.

Instead of making the typewriter carriage move variable amounts in order to accommodate Arabic letters of varying widths the instant characters are standardized so as to permit the use of an escapement mechanism which allows a uniform letter spacing of the typewriter carriage. In Fig. 3 there is shown an enlarged view of a patterned rectangular letter gage 70 which is used to standardize the sizes, relative positions and to some extent the shapes of each of the preterminal and terminal

characters shown in Fig. 1. The dimensions of gage **70** will be illustratively defined assuming that the typewriter carriage is to move one twelfth of an inch for each letter space. The vertical and horizontal dimensions of the rectangular gage **70** are each equal to one sixth of an inch. The lines **71** and **72** designate the horizontal and vertical typing center lines respectively of any given type. The two parallel angular lines **73** and **74** intersect the horizontal typing line **71** at the two points **75** and **76** respectively which are of particular significance and will be hereinafter referred to as gage junction points. The points **77, 78, 79, 80** and **81** are equally spaced one twenty fourth of an inch apart. Points **82** and **83** are right and left letter extreme end points respectively and each are located one forty eighth of an inch from points **75** and **84** respectively. The point **85** is midway between the said junction points **75** and **76** which are spaced one twelfth of an inch apart. No part of any letter form will extend to the right any farther than the extreme right hand end point **82**, or to the left any farther than the extreme left hand end point **83**. The upper vertical limits for any letter form are defined by the line **86** of said gage **70**. It will be understood that the various dimensions of the gage **70** may vary from those specifically described above depending on the size, spacing etc. desired for the type characters. The essential features here however are that the distance between said points **75** and **76** should be substantially equal to the distance that the typewriter carriage moves during one letter space and that once a particular sized gage has been selected, it must be used to determine the configuration and position of all the instant terminal and preterminal characters.

The particular size, shape and position of each of the terminal and preterminal characters of Fig. 1 are shown in Fig. 4. Here the terminal and preterminal forms for each Arabic letter is enclosed in a block which is numbered in accordance with the letter numbering of Fig. 1. The pattern of distribution of the letter blocks of Fig. 4 corresponds to that for the letter keys in Fig. 2. Each of the letter forms or characters of Fig. 4 is designed so as to conform with the said letter gage **70** in a predetermined manner. All of the preterminal characters, except those for the six letters numbered 1, 8–11 and 27, when superimposed on said gage **70** will have right and left side junctions or junction points which will be coincident with the said gage junction points **75** and **76**. All of the terminal characters, as well as said six preterminal characters, when superimposed on said gage will have one point, i.e. a right side junction or junction point, which is coincident with said point **75** of the said gage **70**. For the purpose of clarity in illustration only a portion of the gage **70** has been here shown superimposed on each of the letter forms of Fig. 4 and the letter side junctions which are coincident with the junction points **75** and **76** of gage **70** are defined by small white circular areas. It will be understood that the various characters as actually typed will not have any such white areas.

Although the preterminal forms for the six letters numbered 1, 8–11 and 27 have only right side junctions, the extremities of such characters preferably overlie or are geometrically oriented with respect to some predetermined line or point of the letter gage; for example, the respective lower end of each of the preterminal characters rā, wāw, zā, letter numbers **10, 27** and **11**, is adjacent the point **88** of the gage **70** of Fig. 3. Likewise the extremities for each of the preterminal forms of letters, dāl, and dhāl, numbered **8** and **9**, respectively terminate along or near the lines **71** and **73**. The preterminal form for the letter alif, numbered **1**, is disposed substantially parallel to the vertical typing center **72**. The various extremities of said terminal characters preferably overlie or are geometrically oriented with respect to some point or line of gage **70** in a manner similar to that just described for said six preterminal characters. In that the said side junctions for the instant characters are always in a predetermined position relative to the said vertical and horizontal typing center lines **71** and **72** of gage **70** each typed character will be located in a corresponding predetermined horizontal and vertical coordinate position in the successive print receiving letter spaces of the paper being typed on. It will be noted that the overall width of many of the preterminal letter forms, such as $\overline{\text{sin}}$, number **12**, is greater than the distance between the respective junction points of these particular letter forms. In similar fashion a portion of many of the terminal characters, such as hā, number **6**, extends to the right of the right side junction point of these letter forms. In most cases the width of the terminal characters exceeds that for the widest preterminal characters.

In the instant system, by standardizing the various preterminal and terminal characters as shown and described above in connection with Figs. 2 and 4 Arabic words having a pleasing typed appearance may be readily constructed. The successive letters of such words can be properly interconnected and aligned by successively placing the predetermined side junctions of each letter in progressive coincidence in the manner illustrated in Figs. 5 to 8. These figures show the terminal form of the letter Rā, numbered **10**; the preterminal form of the letter sād, numbered **14**, and the preterminal form of the letter mīm, numbered **24**. When these three characters are interconnected so that the left side junction of mīm, Fig. 7, is coincident with the right side junction of sād, Fig. 6 and the left side junction of sād is coincident with the right side junction of rā, Fig. 5, then the word shown in Fig. 8 and meaning "Egypt" will have been formed. When the preterminal form of the said six letters alif, dhāl, dāl, rā, zā or wā are used there will be a slight space between any such characters and the next succeeding character, said six preterminal letter forms having no left side junctions.

It will be noted that when any series of letters are properly interconnected as shown in Fig. 8, the left end portion of each preterminal character will take the place of the junction lines, such as **30** and **31**, required on the medial and final forms of the various letters as shown in Fig. 1. It should be emphasized again that where such a use of only two forms of the Arabic letters is contemplated it is imperative that all the typed letters be accurately and consistently joined and aligned otherwise the typed words are likely to be illegible. By properly interconnecting the standardized terminal and preterminal characters in the manner illustrated by Figs. 5–8 a word will always be clearly legible in that no relative misalignment of the successive characters is possible: also a pleasing and continuous appearance is thereby imparted to the lines defining the word. In that the distance between the successive side junctions of the letters is constant no proportional escapement mechanism is needed for the instant typewriter carriage. As noted above in connection with Fig. 4 the white circular areas denoting the side junctions for the letters of Figs. 5–7 are shown for explanatory purposes and do not appear in the actual typed word of Fig. 8.

The above described system of characters will be shown and described as applied to and embodied in the construction of a portable Arabic typewriter; however, it will be understood that the principles discussed may be applied with equal efficacy to standard and electric typewriters.

Figs. 9 and 10 show the principal parts of the portable Arabic typewriter **100** contemplated by the instant invention. Any parts of the instant machine not specifically shown or described may be similar to those used in conventional type portable Arabic typewriters such as that presently being produced by the Royal McBee Corporation. Further, unless otherwise stated each of the various parts shown is suitably supported on the machine frame.

Referring to Fig. 9, the typewriter **100** comprises a car-

riage **101** which is progressively displaced from left to right during a typing operation by means of cable **102** which passes over the stationary pulley **103**. One end of the cable is secured to the carriage while the other end is connected to the usual spring biased carriage feed drum. The letter spacing of the carriage **101** is controlled by the escapement mechanism **104**; said mechanism having a pinion **105** which engages the rack **106** secured to the carriage frame. It will be assumed here that the rack **106** has twelve teeth per inch of length.

The typewriter is provided with a vertically movable segment **107** which pivotally supports a plurality of type bars such as **108** which may be respectively actuated to type characters in the usual manner on a record sheet that is operatively supported by the cylindrical platen **109**. Each of said type bars is actuated by depression of a key such as **110** which in this particular case is connected to type bar **108** through the links **111**, **112** and **113**. Secured to the segment **107** is a pair of rearwardly extending arms **114** whose free ends pivotally support the shaft **115**. Rotatably secured to shaft **115** are two arms **116** and **117**. The lower end of arm **116** is pivotally connected to the rearward extension **118** of the conventionally mounted and operated universal bar **119** supported in the said segment **107**. The arm **117** overlies the laterally extending arm **120** of bail **121** which is pivotally supported on the upright shaft **122**. The forwardly extending arm **123** of bail **121** is adapted to engage and actuate the depending arm **124** of the pivotally mounted dog supporting arm **125**, Fig. 10. Secured to said arm **125** is a pair of dogs **126** which cooperate in the usual manner with the teeth of the carriage escapement wheel **127**. It will be apparent that when any one of the type bars is actuated its camming surface, such as is shown at **128** on type bar **108**, will rearwardly displace the universal bar **119** which, through the linkage just described, will operate the escapement mechanism **104** thereby allowing the carriage to be moved one twelfth of an inch, or one letter space, to the right as seen in Fig. 9.

The means for shifting the segment **107** to its respective upper and lower positions comprises a pair of shift key levers **130** which are rotatably secured to the cross shaft **131**. Rotatably secured to the right end of shaft **131** is an arm **132** which is connected by means of link **133** to one of the arms **134** that are rotatably secured to the rotatable shaft **135**. The free ends of arms **134** are respectively articulately connected to links **136** which are in turn connected to the segment **107**. The arms **134** are biased in an upward direction by means of springs **138** so as to normally retain the segment **107** in a position permitting the typing of preterminal characters on the record sheet. It will be apparent that when either of the shift keys **59** is depressed, the segment will be displaced downwardly, thereby permitting the typing of terminal characters. Springs **138** restore the segment to its normal position when said shift key levers **130** are released. The above described apparatus of Fig. 9 is conventional in nature and need not be further explained here. The type for the terminal and preterminal characters are located on the type bars in positions which respectively correspond to that of the upper and lower case characters in English typewriters.

It will be recalled from the discussion of Fig. 1 that the last letter of any Arabic word is always written in the terminal form. Here then the shift key **59** must be depressed prior to the typing of any such last letter. In that there is always a space between successive Arabic words, the present invention contemplates the provision of an interconnecting linkage between the said shift and escapement mechanisms so that after any terminal character is typed the carriage escapement will be automatically actuated. During such an operation said escapement will be operated twice rather than once as in the typing of preterminal characters. This feature will eliminate the need for the customary actuation of the space bar of the typewriter after the typing of each word and will permit said space bar to be entirely eliminated from the instant machine if desired.

Referring to Figs. 9 and 10 the shaft **115** has rotatably secured thereto a depending arm **139** having a lower end that is provided with a rearwardly extending lug **140**. A detent **141** is pivotally secured, as at **142**, to said arm **139** and has a stud **143** fixed to the free end thereof. The detent **141** and the lug **140** are provided with bent off ears **144** and **145** respectively which are interconnected by means of the spring **146**. Said spring biases the detent **141** in a counterclockwise direction so that said ear **144** normally engages the upper edge of the lug **140**. The stud **143** overlies the camming surface **147** of the bell crank **148** which is pivotally mounted, as at **149**, on the machine frame. Bell crank **148** is normally biased into engagement with the fixed stop **150** by means of a spring **151** and has a forwardly extending arm **152** which is provided at its free end with an upwardly extending shoulder **153**. Shoulder **153** lies in front of the arm **120** of said bail **121** and is adapted to rock said bail so as to operate the escapement mechanism **104**.

In operation when either of the shift key levers **130** is actuated the segment **107** together with the shaft **115** and the rearwardly extending arms **114** will be lowered. This downward motion of shaft **115** will cause said depending arm **139**, Fig. 10, to be lowered whereby detent **141** will be rotated in a clockwise direction against the action of spring **146** by reason of said stud **143** riding over the camming surface **147** of bell crank **148**. During this operation the bell crank **148** will remain in engagement with the stop **150**. After said shift key lever **130** has been fully depressed and the segment **107** is in a position for permitting terminal characters to be typed, the detent stud **143** will underlie the shoulder portion **154** of said bell crank **148**. After the desired terminal character has been typed and the carriage has been thereby displaced one space to the right in the usual manner, and the depressed shift key lever **130** is released and allowed to move to its normal position by the action of said springs **138**, the depending arm **139** and the detent **141** will be lifted so that the detent stud **143** will engage and lift the shoulder **154** of bell crank **148**. Here the detent **141** cannot rotate in a counterclockwise direction and hence will rotatably displace said bell crank in a counterclockwise direction; said springs **138** being effectively stronger than the spring **151**. The counterclockwise rotation of bell crank **148** will cause said shoulder **153** to engage and rearwardly displace the said lateral arm **120** of the bail **121**. This motion of bail **121**, being the same as that imparted thereto by the normal operation of said universal bar **119**, will operate the escapement mechanism **104** thereby permitting the carriage to move one more letter space to the right. Thus the space required between the last letter of a word and the first letter of the next word is automatically provided for by the restoration of the typewriter segment from its lower position to its normal upper position. When the segment again reaches its normal upper position the stud **143** will have ridden out from under the arcuately displaced shoulder **154** and the bell crank **148** will be restored to its normal position shown in Fig. 9 by the action of said spring **151**.

By using only two forms for each of the letters in the alphabet and by placing the type for both forms of one given letter on one type bar, the operator of the instant typewriter will never have to determine which of several keys to depress in order to type a given letter. Here there is only one key for each of the respective letters and hence the operator will always use the same key to type any one of said letters. In that the type for the preterminal characters are located on the type bars in positions which respectively correspond to that of the lower case type of English typewriters all of the preterminal letters of a word may be typed by merely se-

quentially depressing the proper keys. When a given terminal character of a word is to be typed the shift key **59** is simply depressed and the letter key for typing the preterminal form of the same letter is then actuated. Restoration of the shift key **59** and its associated linkage to normal position will actuate the said escapement mechanism to thereby automatically provide a space between the terminal character just typed and the first letter of the next word. The provision of a conventional type space bar is not essential to the operation of the instant typewriter. It will be seen that the above described operation for the instant Arabic typewriter is as direct, simple and rapid as the operation of a conventional English typewriter and that the typed letters of each Arabic word will be properly aligned and mutually interconnected in the exact and predetermined manner illustrated by Figs. 5–8 so as to form a continuous series of characters. The instant typewriter may be produced very inexpensively in that a minimum number of letter keys are required and no proportional spacing mechanism, space bar or "silent" keys are necessary.

An improved method and apparatus for aligning the type bars of the instant typewriter is shown and described in connection with Figs. 11–16. If the type bars of an Arabic typewriter are not properly aligned the successively typed letters of a word will either be spaced apart or overlapped. In manufacturing and repairing typewriters, the usual method employed to overcome this difficulty is to bend the various type bars of the machine. This is an inefficient trial and error procedure whereby, in effect, each type block is sought to be aligned with some or all of the other type blocks. Even after the bending and the repeated rebending of each of the type bars there is no certainty that all of the type blocks will be finally oriented in their proper relative positions. The basic difficulty here lies in the fact there are no known datum lines or points against which each typed letter may be positionally gaged. This situation may be seen from an inspection of Fig. 15 where it is impossible, by reference only to the letters of the word, to tell which of said letters are out of alignment. For example, it is impossible to determine if the typed letter **14** is too low or if the typed letter **10** is too high in causing the overlap at **165**. Similarly it is impossible to determine if the letter **24** is too far to the right or if the letter **14** is too far to the left in causing the gap or space **166**.

The instant invention offers a method and means for establishing datum lines and points against which each typed letter may be gaged. The concept involved in the instant type bar aligning method is that when each type bar has been operationally aligned with the same fixed datum points which have been typed on a record sheet all of the type bars will then be operationally aligned with each other.

Referring to Fig. 11 there is shown a type block **170** which is secured either permanently or temporarily to one of the type bars such as **108** of the instant machine. The type **172** and **173** formed on the operative face of said block are respectively shaped and sized so as to print on a record sheet a datum gage which is identical to the letter gage shown and described in connection with Fig. 4. For clarity in illustration only a portion of the respective gages **70** are shown in Figs. 11–16. After a record sheet **175**, Fig. 12, has been operatively positioned in the typewriter carriage the type bar carrying the type block **170** is successively actuated (and adjusted if necessary) so as to print a continuous succession of said datum gages as shown in Fig. 12. In that the escapement mechanism for the instant typewriter always allows the carriage to move from left to right one twelfth of an inch between each successively typing stroke, and in that the distance between the points **75** and **76** of the datum gage is also one twelfth of an inch, it will be apparent that the line **73** and points **75** of any one of said typed datum gages respectively overlie or are coincident with the line **74** and point **76** of the next preceeding typed gage. When said type bar has been adjusted so as to type the continuous gage pattern shown in Fig. 12, each typed gage will be oriented in corresponding position in each of the respective successive letter receiving spaces of the record sheet **175** and hence will provide a common datum from which positional deviations of any typed letters respectively superimposed thereon may be measured. One all the type bars have been aligned with respect to said typed gages they will then of necessity be aligned with each other.

By utilizing the typed datum gages of Fig. 12 the instant type bar aligning method will make it possible to determine not only which letters of the word of Fig. 15 are out of alignment but also the direction and extent of such misalignment. To accomplish this four separate gages are typed on the record sheet **175** as shown in Fig. 13, and then the four letters of Fig. 15 are respectively typed over these four gages (whether the letters are superimposed on the gages or vice-versa is immaterial). If each of the type bars associated with said four letters is in proper alignment, then each of the side junctions of the typed letters **24, 14, 10** and **28**, will overlie the respective junction points **75** and **76** of said four gages. It may be readily seen from Fig. 13 that there is no such positional coincidence between the three typed letters **14, 10** and **28** and their respective associated gages; letter **14** being rotatably twisted in a counterclockwise direction, letter **28** being too high and letter **10** being too far to the right. On the other hand it may be seen that there is a proper positional coincidence between the side junctions of the letter **24** and the junction points of its associated datum gage. The respective type bars for the three letters **14, 10** and **28** may then be bent or otherwise positionally adjusted in the typewriter so that when each of these three letters are typed they will be properly oriented with respect to said gages as shown in Fig. 14. Thereafter, with all four of the said type bars aligned with said gages, the word of Fig. 15 may be typed so that each of the successive letters thereof are then properly oriented with respect to each other as shown in Fig. 16, and the various side junctions of the letters will be joined in the manner described above in connection with Fig. 8.

Thus it will be seen that the system of side junctions for the letters described above in connection with Fig. 4 not only serves to facilitate the interconnection and the standardization of the instant Arabic characters, but also serves as a basis for readily and efficiently checking the alignment of the type bars of the instant typewriter.

While there is in this application specifically described one form which the invention may assume in practice, it will be understood that this form of the same is shown for purposes of illustration only and that the invention may be modified and embodied in various other forms without departing from its spirit or the scope of the appended claims.

The invention claimed is:

1. In a typewriter, a frame, a record supporting carriage movably mounted on said frame, a plurality of selectively operable type bars movably mounted on said frame, a pair of type mounted on each of said type bars, each pair of type being formed so as to type on the record sheet supported in said carriage two forms of one given letter, the majority of characters of one of said forms each having predetermined right and left side junction points which are successively coincident when said characters are successively typed, a portion of many of said characters extending to the right of the respectively associated right side junction points thereof, and escapement means permitting said carriage to intermittently move from left to right during the typing of said characters through distances which are substantially equal to the distances between the said right and left side junction points of said characters respectively.

2. In an Arabic typewriter, a frame, a record support-

ing carriage movably mounted on said frame and adapted to be displaced from left to right during a typing operation, a plurality of selectively operable type bars movably mounted on said frame, each of said type bars having two types formed thereon which are respectively shaped so as to print on the record supported by the carriage a terminal and a preterminal form for each of the letters of the Arabic alphabet, said terminal forms being substantially the same as the independent forms of the corresponding conventional Arabic letters while the preterminal form for each of said letters except alif, dāl, dhāl, rā zā, and wāw being substantially the same as the initial forms of the corresponding conventional Arabic letters, each of the preterminal characters excepting said six letter forms having predetermined right and left side junction points the respective distances between which are substantially the same, the maximum width of the terminal characters being greater than that of said preterminal characters and a portion of most of said preterminal characters extending to the right of the respectively associated right side junction points thereof, and escapement means permitting said carriage to intermittently move from left to right during typing of said preterminal characters through distances which are substantially equal to the distances between the said right and left side junction points of said preterminal characters respectively.

3. Apparatus as defined by claim 2 wherein the type for the preterminal characters are located on said type bars in positions which respectively correspond to that of the lower case type of an English typewriter.

4. In an Arabic typewriter, a frame, a record supporting carriage movably mounted on said frame and adapted to be displaced from left to right during a typing operation, a plurality of selectively operable type bars movably mounted on said frame, each of said type bars having two types formed thereon which are respectively shaped so as to print on the record supported by the carriage a terminal and a preterminal form for each of the letters of the Arabic alphabet, terminal forms being substantially the same as the independent forms of the corresponding conventional Arabic letters while the preterminal form for each of said letters except alif, dāl, dhāl, rā, zā and wāw being substantially the same as the initial forms of the corresponding conventional Arabic letters, each of the preterminal characters excepting said six letter forms having predetermined right and left side junction points, a carriage escapement mechanism, means for shifting the relative positions of said type bars and said carriage so as to change the set of type which may operably strike said record, and means responsive to the operation of said last mentioned means for actuating said escapement mechanism.

5. Apparatus as defined by claim 4 wherein the major ity of preterminal letter forms each have predetermined right and left side junction points the uniform distance between which is substantially equal to the distance through which the typewriter carriage is permitted to move during one letter spacing displacement.

6. Apparatus as defined by claim 4 wherein said actuating means is connected so as to operate said escapement mechanism during the restoration of said shift means to normal position.

7. In a typewriter; a frame, a plurality of selectively operable type bars movably mounted on said frame, a record supporting carriage movably mounted on said frame, an escapement mechanism permitting said carriage to move through successive letter spaces, shift means movable from a normal position for relatively displacing said carriage and type bars so that a different set of type may strike the record sheet, means responsive to the operation of said shift means for actuating said escapement mechanism, a pair of type secured to the end of each of said type bars, one of said type being adapted to type a preterminal form of an Arabic letter and the other said type being adapted to type a terminal form of the same letter, the preterminal letter forms when successively typed having predetermined coincident side junction points.

8. Apparatus as defined by claim 7 wherein the type for said preterminal characters are located respectively on said type bars in positions which respectively correspond to that of the lower case type of an English typewriter, and wherein the type for said terminal letters are located on said type bars in positions which respectively correspond to that of the upper case type of an English typewriter, the majority of preterminal letters forms having predetermined right and left side junction points which are spaced apart a distance equal to the distance which said carriage moves during said letter spacing operations, most of said preterminal characters having an overall width which is greater than the distance between said respective junction points.

9. Apparatus as defined by claim 8 wherein the type for the terminal and preterminal letters forms of each Arabic letter are on the same type bar.

10. In an Arabic typewriter, a frame, a record supporting carriage movably mounted on said frame, a plurality of selectively operable type bars movably mounted on said frame, a pair of type mounted on each of said type bars and adapted to type terminal and preterminal Arabic characters on a record sheet, the type for the preterminal letter forms being located on said type bars in positions which respectively correspond to that of the lower case type of an English typewriter, the type for the terminal and preterminal forms of a given letter being on the same type bar, the majority of the characters for the preterminal letter forms being formed so as to have predetermined right and left side junctions which are successively coincident when said letter forms are successively typed a portion of many of said characters extending to the right of the respectively associated right side junction points thereof, and escapement means permitting said carriage to intermittently move from left to right during the typing of said characters through distances which are substantially equal to the distances between the said right and left side junction points of said characters respectively.

11. In an Arabic typewriter; a frame, a plurality of selectively operable type bars movably mounted on said frame, a record supporting carriage slidably mounted on said frame, an escapement mechanism permitting said carriage to move from left to right during a typing operation, shift means operable to change the set of type which strikes said record, and means responsive to the restoration of said shift means to its normal position for actuating said escapement mechanism.

12. In an Arabic typewriter, a frame, a record supporting carriage movably mounted on said frame, an escapement mechanism supported by said frame and adapted to permit said carriage to be successively spaced from left to right during a typing operation, a plurality of type bars movably mounted on said frame, a pair of type formed on each of said type bars, each pair of said type being shaped so as to respectively print on the record sheet a terminal and preterminal form for each of the letters of the Arabic language, the majority of preterminal letter forms having predetermined side junctions the distance between which is substantially equal to the distance through which the typewriter carriage is permitted to move during a letter spacing displacement, shift means movable from a normal position for changing the relative positions of said type bars and said carriage, and means responsive to the restoration of said shift means to its normal position for operating said escapement mechanism.

13. A method of aligning the type bars of a typewriter; comprising the steps of, operatively positioning a record sheet in the typewriter, typing a letter gage in each of a plurality of letter spaces on said record, said gages being respectively located in the same known position in each of the respective letter spaces, successively actuating the said type bars so as to type a letter over each of said

gages, and adjusting the operative position of each of said type bars so that predetermined junction points of the letters respectively typed thereby overlie predetermined points of the respective gages in predetermined positional coincidence.

14. The method defined by claim 13 wherein the type and the associated type bar used for printing said gages are constructed and adjusted so that the successively typed gages have predetermined junctions which are respectively in successive coincidence.

15. Apparatus as defined by claim 11 wherein said escapement mechanism permits said carriage to intermittently move through increments of uniform length.

16. Apparatus as defined by claim 11; additionally comprising a pair of type secured to each of said type bars, each of said pairs defining the terminal and preterminal

forms of a given Arabic letter, the locations of said type on said type bars being such that the terminal letter forms respectively positionally correspond to the upper case type of an English typewriter and the preterminal letter forms respectively positionally correspond to the lower case type of an English typewriter.

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