

[54] **HAND-OPERATED TYPEWRITER**

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[57] **ABSTRACT**

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A hand-operated typewriter with a segment shift mechanism has several key lever shafts supported on a frame in several rows at different heights and at different distances from the front or operator side of a frame (the type being towards the rear side of the frame) for pivotally mounting key levers, the number of shafts being more than the number of key rows. The key levers corresponding to the keys which are positioned in an outer part of each row of keys (i.e., away from the center or inner part of the typewriter) are pivotally supported on a shaft which is disposed at a position higher than the shaft on which the key levers corresponding to keys positioned in a center part of each row are supported, so as to make the strokes of all the keys depressions uniform.

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[51] Int. Cl..... **B41j 23/08**

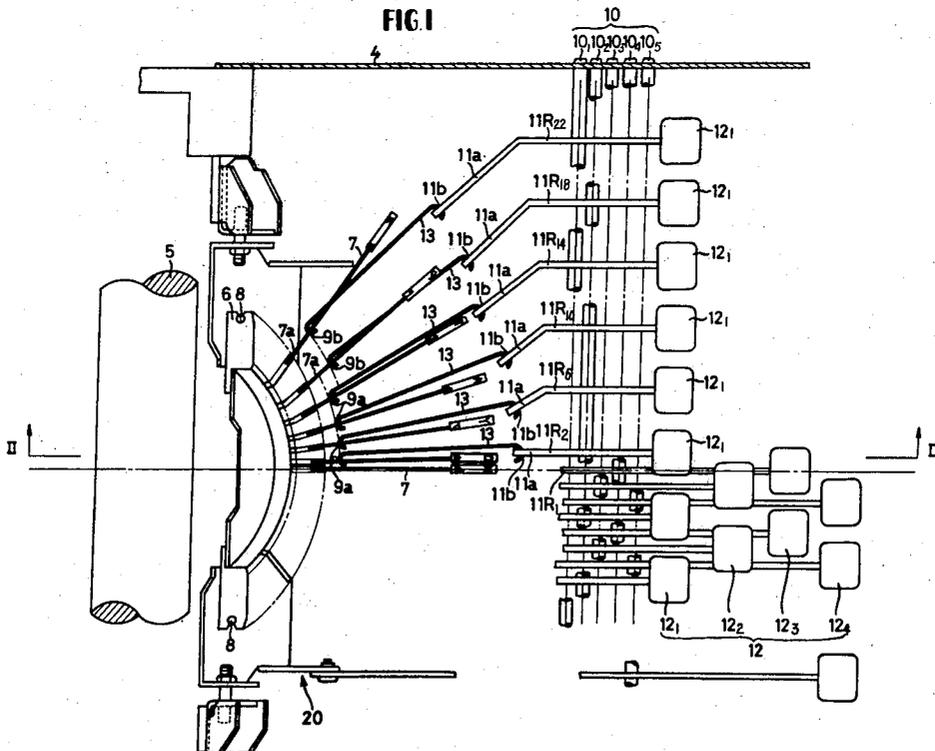
[58] Field of Search..... 197/17, 21-23,
197/27-34, 98

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6 Claims, 4 Drawing Figures



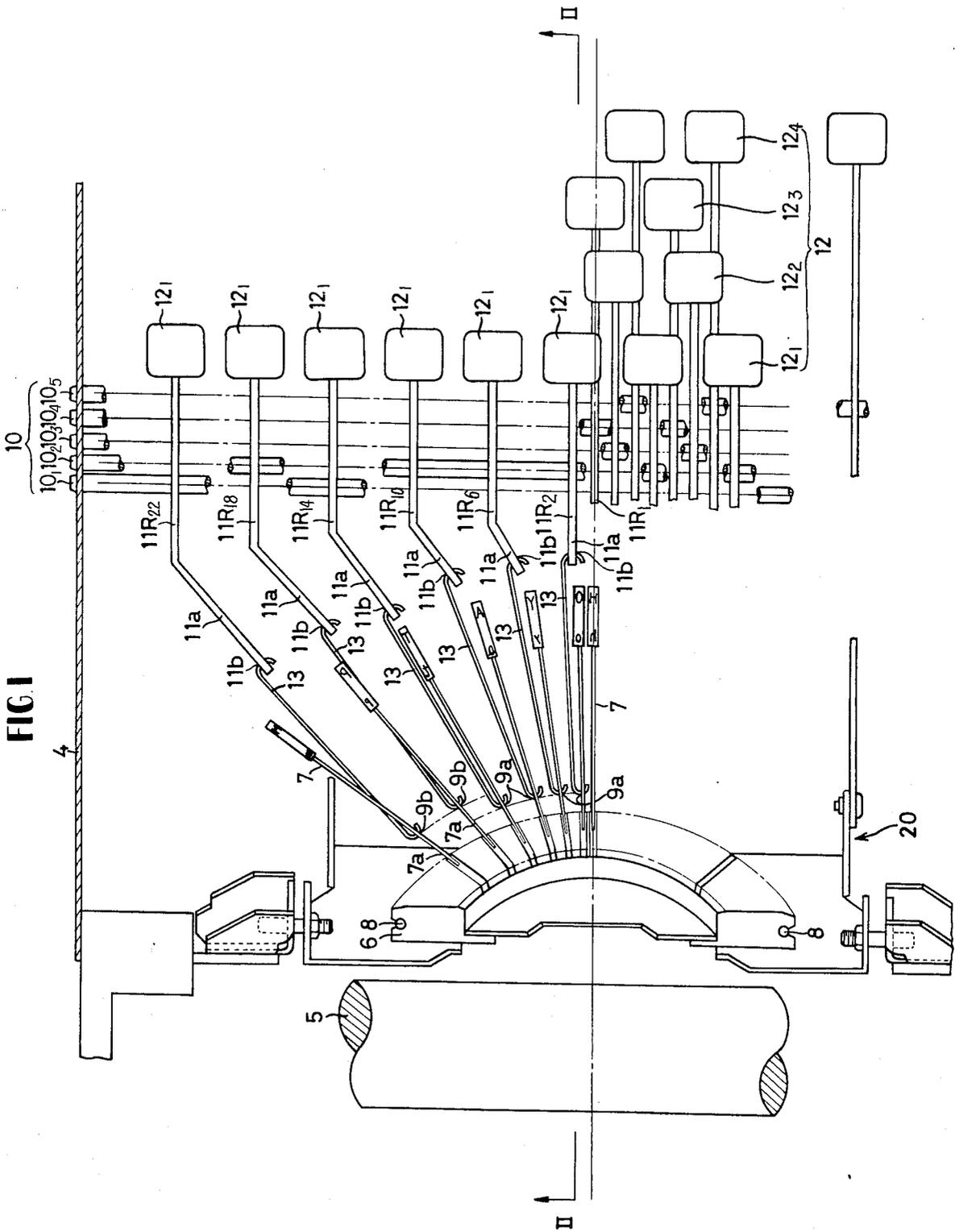


FIG 2

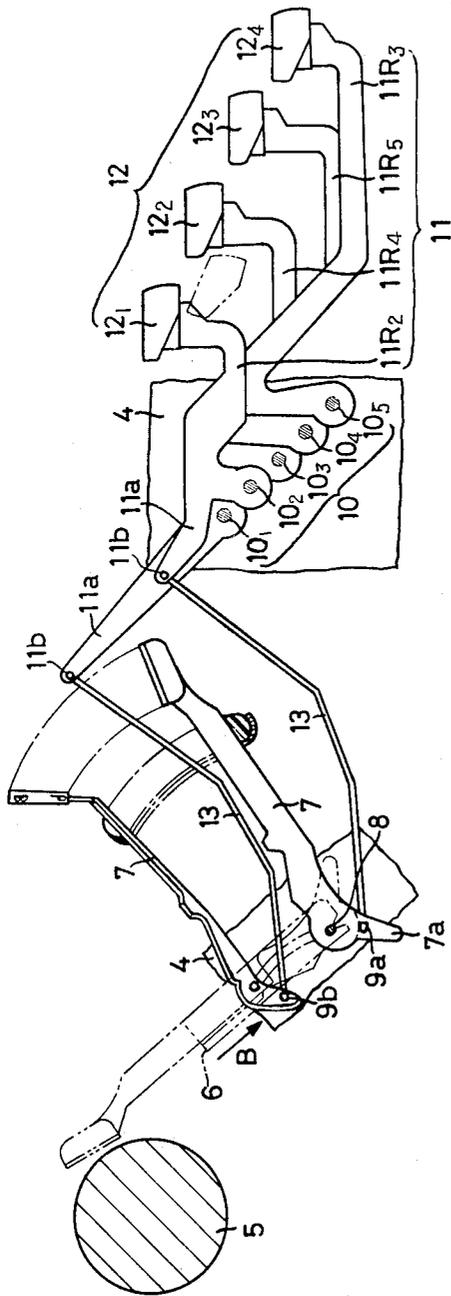


FIG 4

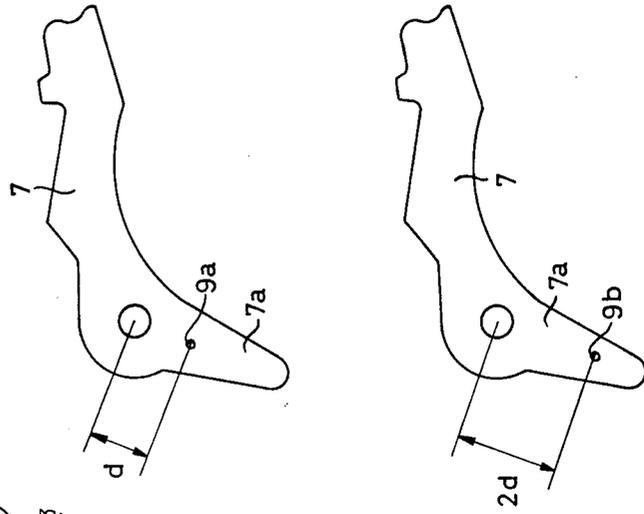
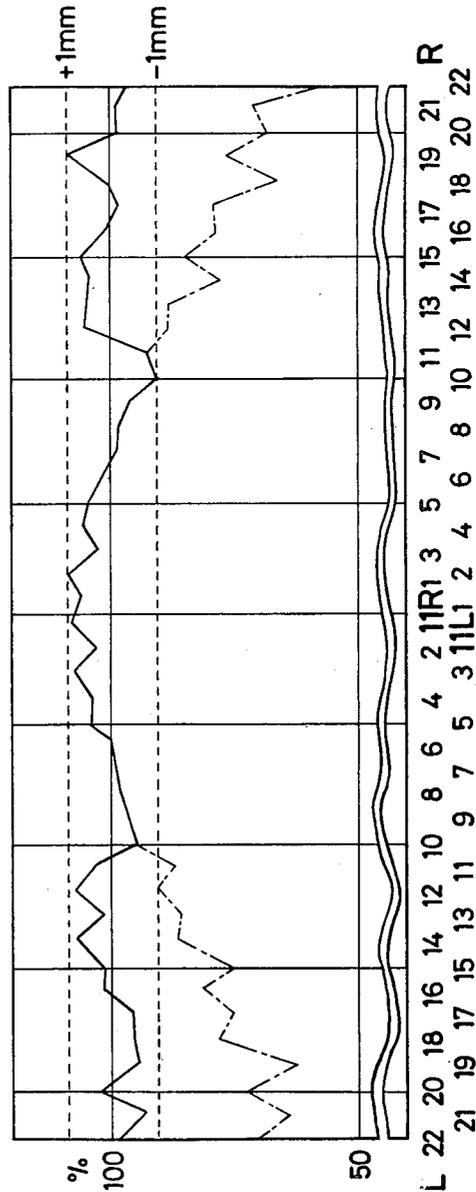


FIG 3



L 22 20 18 16 14 12 10 8 6 4 2 11R1 3 5 7 9 11 13 15 17 19 21 R
 21 19 17 15 13 11 9 7 5 3 11L1 2 4 6 8 10 12 14 16 18 20 22

HAND-OPERATED TYPEWRITER

BACKGROUND OF THE INVENTION

This invention relates to a printing mechanism for typewriters, and more particularly to a printing mechanism suitable for use in typewriters in which key levers are directly connected with type levers by means of type bar wires without using a bell crank lever which is usually employed for connecting the key levers with the type bar wires in currently used hand-operated typewriters.

BRIEF DESCRIPTION OF THE PRIOR ART

In the printing mechanism of typewriters presently in use with the type bar segment shift mechanism which is adapted to shift the type bar segment carrying a set of semicircularly aligned type bars, it is necessary to maintain the linkage point between the bell crank lever and the type bar wires in the same position no matter whether the type bar segment is in a shifted position or in a non-shifted position. In this connection, the linkage point which is at an equal distance in both the shifted and non-shifted positions with regard to the respective type bars has a semicircular line running along the semicircle of the type bar segment and having a center point on the same side as the type bar segment. That is to say, the distance between the linkage points and the pivot points of the key levers which are mounted on a common rectilinear key lever shaft is smallest at the center and becomes gradually greater towards the outer wings of the shaft, the outermost key levers having a pivot point at a distance about two times larger than the key lever at the center of the shaft.

On the other hand, the angles of the rocking movement of the type bars are substantially equal in the center and outer portions of the type bar segment. Therefore, in the printing mechanism having the type bars directly connected to the key lever with type bar wires, the key levers in the outer portions of the keyboard have to be pivoted through angles which are different from the angles of the key levers in the center portion of the keyboard in order to rock the respective type bars through an angle sufficient for a satisfactory typing operation. The variations in the pivoting angle of the key levers usually results in variations in the amount of the depression stroke and resistance to depression between the respective keys, giving an unpleasant key touch to a typist to such a degree as to make practical typing operations extremely difficult. To deviate these difficulties, it is the usual practice in known typewriters with a segment shift mechanism to connect the respective key levers to the respective type bar wires by way of a particular linkage means which can vary the transmitting ratio from the key lever to the type bar wire to compensate for variations in the depression stroke of the respective keys. However, such measure is usually found unsatisfactory and only contributes to complications both in the printing mechanism and in assembling the typewriters. For these reasons there are high production cost involved in typewriters with a segment shift mechanism.

OBJECTS OF THE INVENTION

It is therefore an object of this invention to provide a hand-operated typewriter with a segment shift mechanism, wherein all the keys are depressible through a substantially uniform stroke.

It is another object of this invention to provide a hand-operated typewriter with a segment shift mechanism, which is mechanically simple and inexpensive to manufacture.

It is still another object of this invention to provide a hand-operated typewriter with a segment shift mechanism, which requires a uniform effort to depress a key.

SUMMARY OF THE INVENTION

In accordance with this invention, a typewriter with a segment shift mechanism has several key lever shafts supported on a frame in several rows at different heights and at different distances from the front or operator side of a frame for pivotally mounting key levers, the number of shafts being more than the number of key rows. The key levers corresponding to the keys which are positioned in the outer part of each row of the typewriter (i.e., away from the center or inner part of the typewriter) are pivotally supported on a shaft which is disposed at a position higher than the shaft on which the key levers corresponding to keys positioned in a center part of each row are supported, so as to make the strokes of all the keys depressions uniform.

In a preferred form of this invention, the typewriter has connecting apertures provided at the boot end part of the type bars. There are at least two kinds of apertures at different distances from the pivot wire of the type bars, one connecting apertures at a rather short distance from the pivot wire is connected with a connecting member corresponding to one of the keys positioned in a center part of each row of the keys, another connecting aperture at a rather long distance from the pivot wire is connected with a connecting member corresponding to one of the keys positioned in an outer part of each row of the keys so as to make the strokes of all the key depressions uniform.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary plane view of a portion of a typewriter constructed in accordance with the invention;

FIG. 2 is a fragmentary cross-sectional view taken along lines II—II of FIG. 1;

FIG. 3 is a graph for illustrating a depressible stroke of each key;

FIG. 4 is a greatly enlarged segmentary side view of the type bar.

DETAILED DESCRIPTION OF THE INVENTION

Referring first to FIG. 1 which shows essential component members of a printing mechanism contemplated herein, there is shown side frames 4 of the typewriter and platen 5 rotatably mounted on the side frames 4. Supported on the side frames 4 is a type bar segment 6 which is shiftable in the usual manner between two positions (a shifted position and a non-shifted position) as seen in FIG. 2 by means of a shifting mechanism. A conventional segment shift mechanism 20 is also shown. A set of type bars are aligned in a semicircular fashion on the type bar segment 6. Each type bar is provided a type including two characters.

The type bars 7 are rockably supported on a pivot wire 8 which is mounted in a semi-circular fashion on the type bar segment 6, with the heel ends 7a of the type bars 7 projecting outwardly (FIG. 2 and 4). The heel ends 7a of the type bars are each formed with a linking aperture, more particularly, with both a linking aperture 9a, which is spaced from the pivot wire 8 by a distance d and a linking aperture 9b which is spaced from the pivot wire by a distance $2d$ (FIG. 4).

Designated at 10 are five key lever shafts, 10₁ to 10₅, which are securely supported at opposite ends of the side frames 4 and disposed parallel to the platen 5. The key lever shafts are located in five rows at different heights and different distances from an operator side or front side of the frame 4. That is to say, the key lever shafts are arranged in five steps and designated by reference numerals 10₁, 10₂, 10₃, 10₄ and 10₅ from the upper and lower ones. A set of key levers 11 are rockably mounted at the center portions thereof on the key lever shafts 10. In the particular example shown, 22 key levers are mounted on each of the lefthand and righthand side of the keyboard. These are designated as 11L₁ through 11L₂₂ and 11R₁ through 11R₂₂ in FIG. 3.

Each key lever 11 has secured to one end thereof a character key 12. The keys 12 are aligned in rows of four at different heights respectively and different distances from an operator side or front side of frame 4. That is to say, the keys are arranged in four steps which are designated by reference numeral 12₁, 12₂, 12₃ and 12₄ from the upper to the lower ones. On the other hand, the key levers 11 are each formed with a linking opening 11b at the tip of the rear end 11a (the front end being towards the operator) for connection to one end of a type bar wire 13 which will be described in more detail hereinafter. As shown particularly in FIGS. 1 and 2, the rear ends 11a of the key levers 11 are so shaped that the distance between the key lever shaft 10 and the linking opening 11b becomes greater from the center towards the outer sides of the keyboard, and at the same time the rear ends 11a of the key levers 11 are turned angularly, as shown in FIG. 1, so that the rear ends 11a can pivot on the same radial planes as the corresponding type bars 7 on the type bar segment 6. As the typewriter is of the segment shift type, the linking openings 11b at the rear ends 11a of the key levers have to be maintained at a constant distance from the linking aperture 9 of the type bars 7 no matter whether the segment 6 is in its shifted or non-shifted position. To this end, the centers of the linking opening 11b at the rear ends 11a of the key levers 11 are disposed on a semicircular line drawn along and having a center point on the same side as the semicircular type bar segment 6 as shown in FIG. 1. Connected to linking openings 11b are type bar wires 13 each having one end threaded into a linking aperture 9 of a type bar 7 and the other end into linking opening 11b, thereby interconnecting the type bar 7 and the corresponding key lever 11.

With a typewriter of the construction as described above, the key lever 11 is rocked upon depressing the key 12 and the action of the key lever 11 is transmitted to the type bar 7 through the type bar wire 13, rotating the type bar 7 to attain the desired impact.

On the other hand, as mentioned hereinbefore, the distance from the pivot point of the key lever 11 to the linking opening 11b at the rear end 11a of the key lever 11 is increased gradually from the centers toward the opposite outer sides of the keyboard. More particu-

larly, the aforesaid distance of centrally positioned key lever 11R₂ and the outermost key lever 11R₂₂ are in a ratio of about 1:2. Therefore, the rocking angle of the key lever 11 has to be decreased gradually from the center towards the outer sides of the keyboard in order to drive the respective type bars 7 through uniform rocking angles. However, the variations in the rocking angle of the key levers result in corresponding variations in the depression stroke length and also in the resistance to depression of the respective keys 12. For this reason, it is necessary to employ the linkage arrangement as in the present invention.

More particularly, according to the present invention, the relations between the positions of the respective key levers 11 and of the key shafts 10 on which the key levers 11 are mounted and also the relations between the positions of the key levers 11 and of the linking apertures 9 in the corresponding type bars 7 are suitably selected to hold the depression stroke lengths of the respective keys 12 in a predetermined range (with depression stroke differentials of only ± 1 mm, FIG. 3). The type actions according to the invention will now be described in greater detail in connection with several keys 12₁ of the uppermost row which are positioned on the righthand of the keyboard.

Before proceeding to the description of the actions of particular key levers, it may be mentioned that the key levers for the keys 12₁ in the uppermost row are mounted on the first and second key lever shafts 10₁ and 10₂; the key levers for the keys 12₂ in the second row are mounted on the second and third key lever shafts 10₂ and 10₃; the key levers for the keys 12₃ in the third row are mounted on the third and fourth key lever shafts 10₃ and 10₄; and the key levers 12₄ in the lowermost step are mounted on the fourth, and fifth key lever shafts 10₄ and 10₅ as shown in FIG. 1.

Of the key levers 11R₂, 11R₆, 11R₁₀, 11R₁₄, 11R₁₈ and 11R₂₂ for the keys 12₁ in the upper most step, the description is first directed to the key levers 11R₂, 11R₆ and 11R₁₀ which are pivotally mounted on the second key lever shaft 10₂ and the key lever 11R₁₄ which is pivotally mounted on the first key lever shaft 10₁. In this connection, FIG. 3 graphically shows variations in the depression stroke length of the respective keys 12, wherein the depression strokes are taken on the ordinate in terms of percentage with regard to an optimum depression stroke at 100% and the upper and lower limits of the allowable range of ± 1 mm are indicated by broken lines. While, in the graph of FIG. 3, the respective key levers are taken on the abscissa consecutively by their reference numbers. The dot and dash line indicates variations in the depression stroke of the keys in a case where no selection is allowed with regard to the key lever shafts 10 and the linking aperture 9, for example, in a case where the key levers 11 for the uppermost keys 12₁ are supported in common on the second key lever shaft 10₂ and only the nearer linking apertures 9a are used for connection to the respective type bars 7. On the other hand, the solid line shows variations in the key depression stroke when the differently positioned two linking apertures and key lever shafts are selectively used for keys of the same row, for example, when both the nearer linking apertures 9a and distant linking apertures 9b are used in combination with either the first key lever shaft 10₁ or the second key lever shaft 10₂ for the keys 12₁ of the uppermost or first row.

As will be clear from consideration of the dot and dash line in FIG. 3, the depression stroke of the keys 12₁ of the uppermost or first row which are supported on key levers 11R₂, 11R₆ and 11R₁₀ is reduced gradually outwardly but within the allowable range which is indicated by broken lines in FIG. 3. However, the depression stroke of the key on the key lever 11R₁₄ is reduced to a point far below the lower limit of the allowable range. This can be rectified by mounting the key lever 11R₁₄ on the first key lever shaft 10₁ instead of the second key lever shaft 10₂ since the distance from the key 12₁ to the key lever shaft 10 is increased and therefore an increased depression stroke is required for pivoting the rear end 11a of the key lever 11R₁₄ through a predetermined angle. In this manner, the depression stroke of the key 12₁ on the key lever 11R₁₄ may be suitable held within the allowable range.

On the other hand, with regard to the connection between the type bars 7 and the type bar wires 13, the key levers 11R₂, 11R₆, 11R₁₀ and 11R₁₄ are connected to the respective type bars 7 by way of type bar wires 13 which are all in engagement with linking apertures 9a nearer to the pivot wire 8 of the type bars 7. However, the key lever 11R₁₈ which is mounted on the second key lever shaft 10₂ together with the key levers 11R₂, 11R₆ and 11R₁₀ is connected to the type bar 7 by way of the linking aperture 9b distant from the pivot wire 8. This is because, if the connection were not switched to the distant linking aperture 9b, the depression stroke of the key lever 11R₁₈ would deviate from the allowable lower limit to a far greater degree than the key lever 11R₁₄ as indicated by the dot and dash line in the graph of FIG. 3. However, the depression stroke of the key lever 11R₁₈ may be held within the allowable range indicated by broken lines in FIG. 3 by switching the connection from the nearer linking aperture 9a to the distant linking aperture 9b instead of changing the key lever shaft 10.

The switching of the connection from the nearer linking aperture 9a to the distant linking aperture 9b of the type bar 7 means that the amount of the rocking movement of the type bar 7 is reduced with the same amount of rocking movement by the key lever 11. That is to say, as rocking amount which the key lever 11 is required to rock the type bar 7 through a given angle is increased, the depression stroke of the key 12 is increased.

Moreover, the key lever 11R₂₂ which is located on the righthand side of the keyboard is mounted on the first key lever shaft 10₁ and connected to the type bar 7 by means of a type bar wire 13 which is in engagement with the distant linking aperture 9b of the type bar 7. This is because, if the key lever 11R₂₂ were not effected by way of the first key lever shaft 10₁ and the connection to the type bar 7 were not effected by way of the distant linking aperture 9b in linking the key lever 11R₂₂ which is located in the rightmost position on the keyboard, the depression stroke of the key on the key lever 11R₂₂ would deviate greatly from the allowable range indicated by broken lines in FIG. 3 and would become too small and be about one half of the depression stroke of a key located at the center of the keyboard. Therefore, in this instance, the depression stroke of the key 12₁ is adjusted to the allowable range by switching not only the key lever shaft 10 but the linking aperture 9.

More particularly, the depression stroke of the key 12₁ on the key lever 11R₂₂ is increased by mounting the key lever 11R₂₂ on the first key lever shaft 10₁ and at the same time the type bar wire 13 for the key lever 11R₂₂ is connected to the distant linking aperture 9b for further increasing the depression stroke of the key 12₁.

It will be appreciated that, though the foregoing description is given only in connection with the keys of the uppermost row, the same principles can be applied to the keys in other rows. Namely, the keys of other rows may be adjusted to have a depression stroke within the allowable range of FIG. 3 by selecting either the second key lever shaft 10₂ or third key lever shaft 10₃ for the keys of the second row 12₂ and either the third key lever shaft 10₃ or the fourth key lever shaft 10₄ for the keys of the third row 12₃, either the fourth key lever shaft 10₄ or the fifth key lever shaft 10₅ for the keys of the fourth or lowermost row 12₄, coupled with selection of suitable linking apertures 9a or 9b of the type bars 7.

As described hereinbefore, in the type mechanism for typewriters according to the present invention, the key lever shafts are provided in a greater number than the rows of keys so that the keys of each row are mounted on more than one key lever shafts, and the type bars are formed with two kinds of linking apertures at different distances from the pivot wire on which they are supported for connecting the key levers to the respective type bars. The particular aperture used is selected so as to be either a near or a distant linking aperture so as to hold the depression strokes of the respective keys uniform. Since the key levers are directly connected to the respective type bars by means of type bar wires, the construction of the printing mechanism of the typewriter can be significantly simplified allowing the adoption of the segment shift mechanism. It will be appreciated that a typewriter employing the printing number maintenance component parts and allows easy adjustment and maintenance.

It is to be observed therefore that the present invention provides for an improved arrangement for a typewriter wherein symbols, e.g., characters, are typed by applying fingers to keys 12 disposed in rows there being keys located at the center part and the outer part of each row. In this kind of a typewriter there is a frame 4 extending from the front where the operator sits to the rear of the typewriter where symbols are printed. A type bar supporting segment 6 is shiftably mounted on the frame for movement to a high and low position, and this segment 6 has a semicircular pivot wire 8 held therein. Pivotaly supported on said segment 6 by wire 8 are a plurality of type bars 7 having at least two type symbols at the upper end which type symbols can be selectively applied to paper. Also there is a boot shaped part at the lower end of the type bar for pivotal lever action. Connected to the boot shaped part of each type bar 7 by connecting means 13 is a pivoting key lever means 11 so adapted and disposed that the pivoting action of said key lever means 11 and said connecting means 13 on said boot shaped part causes said type bar to pivot about said wire. Also connected to said segment 6 are shift means 20 to move said segment 6 to the high and low positions to select one of the symbols thereon for typing. As an improvement in the foregoing arrangement the present invention provides for several key lever shafts 10 mounted on the frame in several rows at different heights and at different distances from

the front of the frame for pivotally supporting the key levers, the number of said key lever shafts being at least one more than the number of rows of keys.

The key levers for keys positioned in an outer part of each row of keys are pivotally supported in one of said shafts which is located at a position higher than another of said shafts supporting the key levers for keys positioned in a center part of each row so as to equalize the strokes of all the keys.

Thus, said keys are usually arranged in four rows in tiers. The key lever shafts are likewise arranged in five rows, the key levers corresponding to the first row keys from the top of said four rows are alternatively pivotally supported on the first and second row shafts from the top, the key levers corresponding to the second row keys being alternatively supported on the second and third rows shafts; the key levers corresponding to the third row keys being alternatively pivotally supported on the third and fourth row shafts, and the key levers corresponding to fourth rows keys are alternatively pivotally supported on fourth and fifth row shafts.

Furthermore, the type bars have connecting apertures for connecting means 13 in said boot shaped part there being at least two kinds of apertures at relatively near and at a relatively far distance from the pivot wire 8 so as to provide a relatively shorter lever action with the connecting means linked to keys positioned in the center part of each row of keys and forming a relatively longer lever action with the connecting means linked to keys positioned in an outer part of each row of keys so as to equalize the strokes of all the keys.

The connecting apertures are disposed on a substantially semicircular line. Each of the key levers also has a rear connecting opening, said openings likewise being on a substantially semicircular line, the center point of said apertures line and said openings line being substantially in coincidence.

We claim:

1. In a hand-operated typewriter wherein characters are typed by applying fingers to keys (12) disposed in rows, the keys being located at the center part and the outer parts of each row, said typewriter having:

- a. a frame (4) extending from the front near to the operator to the rear far from the operator;
- b. a type bar supporting segment (6) shiftably mounted on said frame, for movement to a high and a low position with a semicircular pivot wire (8) held therein;
- c. a plurality of type bars (7) having at least two type characters at the upper end which can be selectively applied to paper and a boot shaped part at the lower end for pivotal lever action pivotally supported on said segment (6) by said wire (8);
- d. key levers (11) and connecting means (13), there being one key lever (11) connected to the lower end of each type bar (7) by said connecting means (13) so adapted and disposed that the pivoting action of the key lever (11) and said connecting means on said lower end causes type bar to pivot about said wire;
- e. shift means (20) connected to said segment (6) to move said segment (6) to the high and low positions to select one of the characters thereon for typing; wherein the improvement comprises
- f. several key lever shafts mounted on said frame in several rows at different heights and different dis-

tances from the front side of said frame for pivotally supporting said key levers;

- g. said type bars having connecting apertures for said connecting means in the boot shaped part there being at least two kinds of apertures at a relatively near and relatively far distance from said pivot wire;
- h. said key levers corresponding to each row of the keys being supported by using of at least two adjacent shafts of said key lever shafts, the lowest one of said at least two adjacent shafts supporting said key levers corresponding to the keys positioned at the center part of each row of the keys and some of those said key levers which correspond to the keys positioned at the outer parts of each row, and said other shaft or shafts except said lowest shaft supporting other of the keys positioned at the outer parts of each row;
- i. said connecting means corresponding to said key levers of the keys in a center part of each row being connected with said connecting aperture having a rather short distance from said pivot wire;
- j. and said connecting means corresponding to said key levers supported on said other shaft or shafts being selectively connected with said other of said apertures, so that the strokes of all keys are equalized.

2. In a hand-operated typewriter wherein characters are typed by applying fingers to keys (12) disposed in rows, the keys being located at the center part and the outer parts of each row, said typewriter having:

- a. a frame (4) extending from the front near to the operator to the rear far from the operator;
- b. a type bar supporting segment (6) shiftably mounted on said frame, for movement to a high and low position with a semicircular pivot wire (8) held therein;
- c. a plurality of type bars (7) having at least two type characters at the upper end which can be selectively applied to paper and a lower end for pivotal lever action pivotally supported on said segment (6) by said wire (8);
- d. key levers (11) and connecting means (13), there being one key lever (11) connected to the lower end of each type bar (7) by said connecting means (13) so adapted and disposed that the pivoting action of the key lever (11) and said connecting means (13) on said lower end causes said type bar to pivot about said wire;
- e. shift means (20) connected to said segment (6) to move said segment (6) to the high and low positions to select one of the characters thereon for typing; the improvement in said typewriter wherein
- f. several key lever shafts (10) are mounted on said frame in several rows at different heights and at different distances from the front of said frame for pivotally supporting said key levers, the number of said key lever shafts being at least one more than the number of rows of the keys; and wherein said key levers for the keys positioned in outer parts of each row of the keys are pivotally supported on one of said shafts which is located at a position higher than another of said shafts supporting said key levers for the keys positioned in a center part of each row of the keys so as to equalize the strokes of all the keys.

3. A hand-operated typewriter as claimed in claim 2 wherein the keys are arranged in four rows in tiers, said key lever shafts being likewise arranged in five rows, said key levers corresponding to the first row keys from the top of said four rows being alternatively pivotally supported on the first and second row shafts from the top, said key levers corresponding to the second row keys being alternatively pivotally supported on the second and third row shafts; said key levers corresponding to the third row keys being alternatively pivotally supported on the third and fourth row shafts, and said key levers corresponding to fourth row keys being alternatively pivotally supported on fourth and fifth row shafts.

4. In a hand-operated typewriter wherein characters are typed by applying fingers to keys (12) disposed in rows, the keys being located at the center part and the outer parts of each row, said typewriter having:

- a. a frame (4) extending from the front near to the operator to the rear far from the operator;
- b. a type bar supporting segment (6) shiftably mounted on said frame, for movement to a high and a low position with a semicircular pivot wire (8) held therein;
- c. a plurality of type bars (7) having at least two type characters at the upper end which serve to be selectively applied to paper and a boot shaped part at the lower end for pivotal lever action pivotally supported on said segment (6) by said wire (8);
- d. key levers (11) and connecting means (13), there being one key lever (11) connected to the boot shaped part of each type bar (7) by said connecting means (13) so adapted and disposed that the pivoting action to the key lever (11) and said connecting means (13) on the boot shaped part causes said

- e. shift means (20) connected to said segment (6) to move said segment (6) to the high and low positions to select one of the symbols thereon for typing; the improvement in said typewriter wherein
- f. said type bars have connecting apertures for said connecting means (13) in the boot shaped part there being at least two kinds of apertures at a relatively near and at a relatively far distance from said pivot wire (8) so as to provide a relatively shorter lever action with said connecting means linked to the keys positioned in a center part of each row of the keys and forming a relatively longer lever with said connecting means linked to the keys positioned in outer parts of each row of the keys so as to equalize the strokes of all the keys.

5. A hand-operated typewriter as claimed in claim 4 wherein additionally several key lever shafts (10) are mounted on said frame in several rows at different heights and at different distances from the front of said frame for pivotally supporting said key levers, the number of said key lever shafts being at least one more than the number of rows of the keys; and wherein the key levers for the keys positioned in outer part of each row of the keys being pivotally supported on one of said shafts which is located at a position higher than another of said shafts supporting said key levers for the keys positioned in a center part of each row of the keys so as to equalize the strokes of all the keys.

6. A hand-operated typewriter as claimed in claim 5 wherein said connecting apertures are disposed on a substantially semicircular line, said key levers each having a connecting opening, said openings likewise being on a substantially semicircular line.

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