July 10, 1956 R. D. DODGE ET AL 2,753,973

JUSTIFIER FOR TYPEWRITERS

Filed March 12, 1953 9 Sheets-Sheet 1

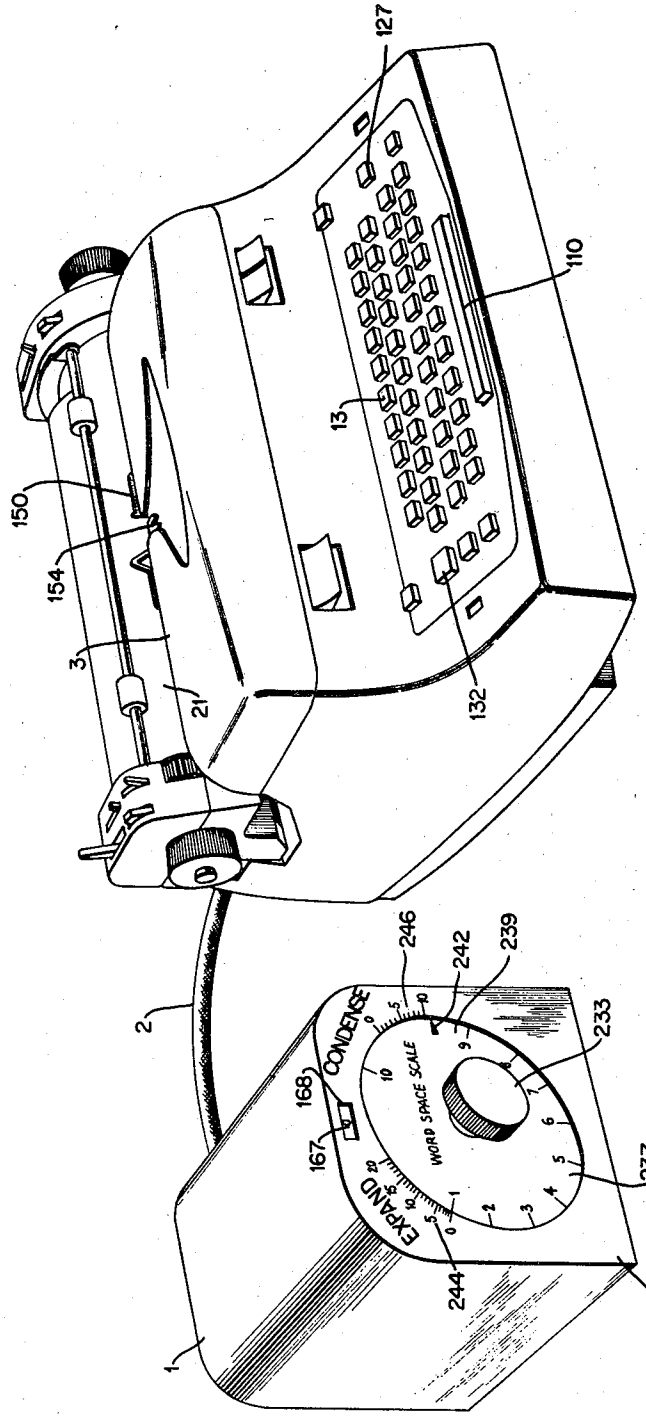


FIG. 1

INVENTORS
R. D. DODGE
L. E. PALMER

BY Murray Nanes
ATTORNEY

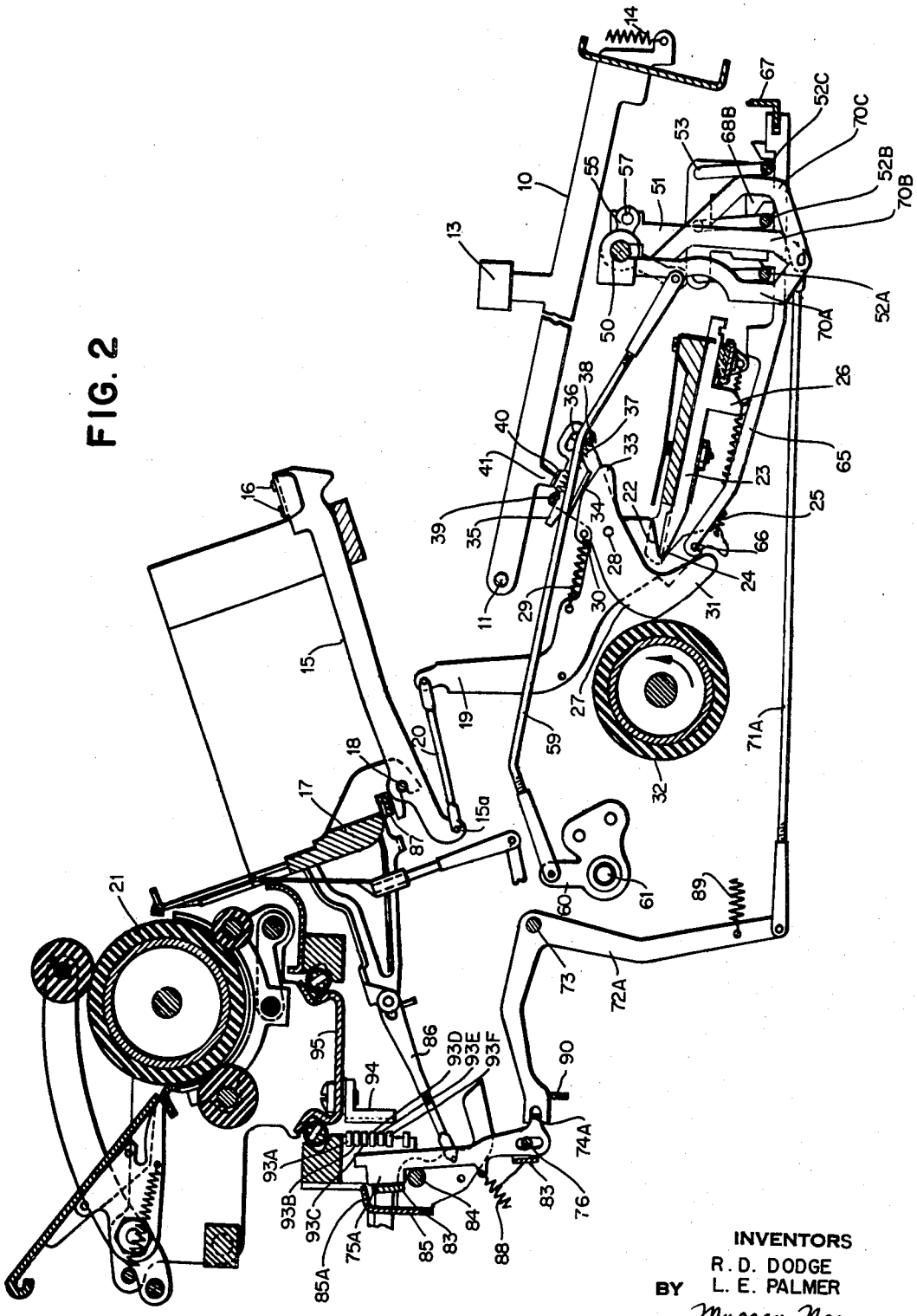
July 10, 1956 R. D. DODGE ET AL 2,753,973

JUSTIFIER FOR TYPEWRITERS

Filed March 12, 1953

9 Sheets-Sheet 2

FIG. 2



INVENTORS
R. D. DODGE
BY L. E. PALMER
Murray Nance
ATTORNEY

July 10, 1956 R. D. DODGE ET AL 2,753,973

JUSTIFIER FOR TYPEWRITERS

Filed March 12, 1953 9 Sheets-Sheet 3

FIG. 4

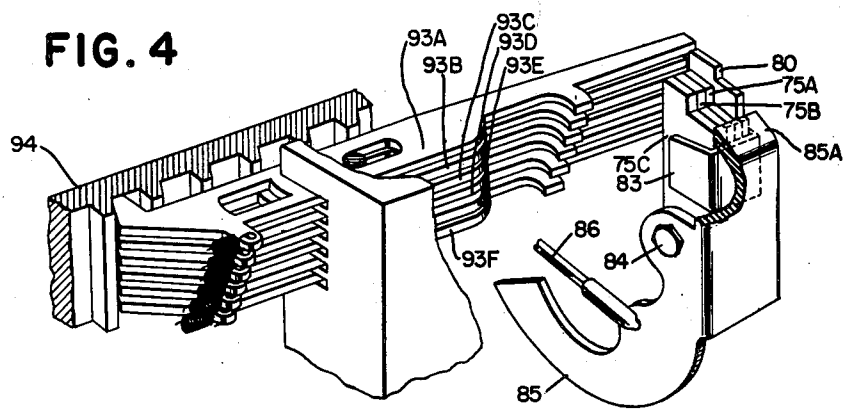
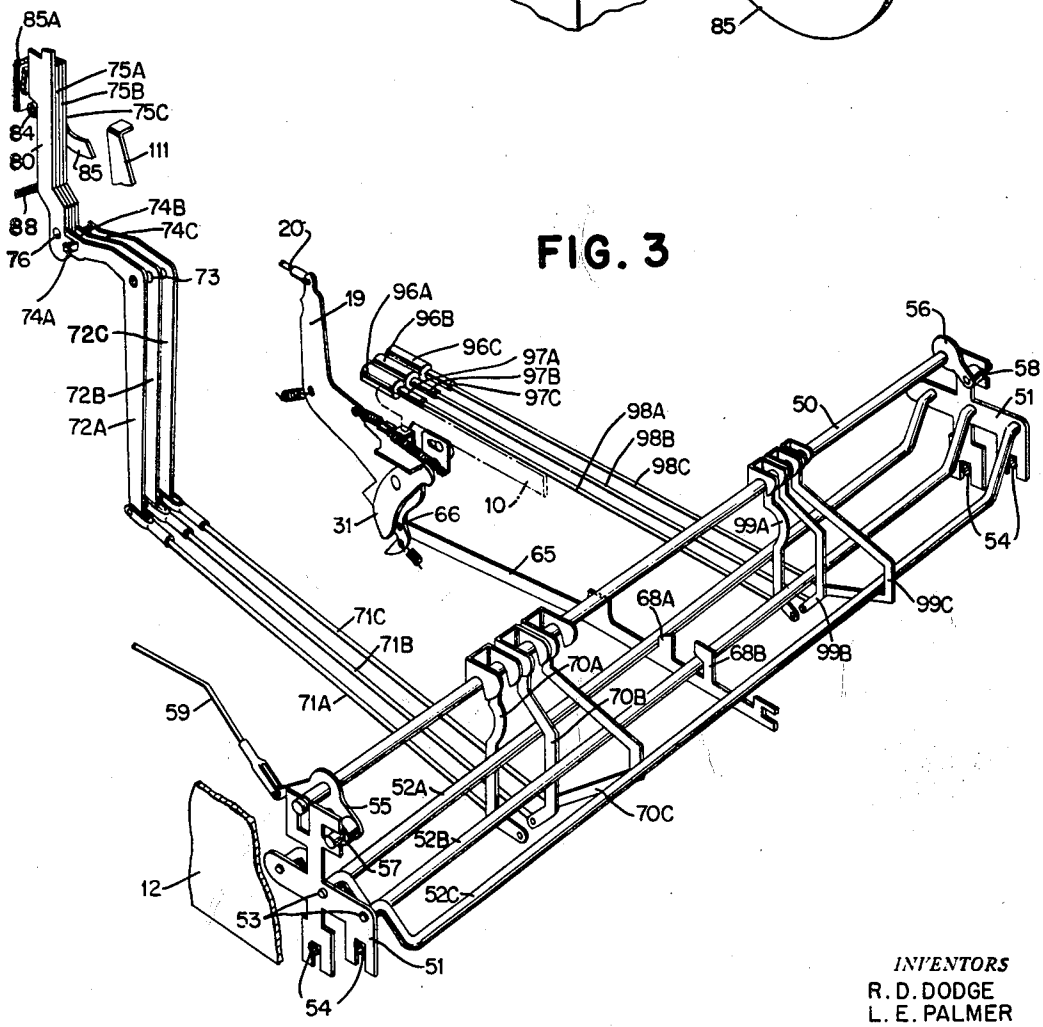


FIG. 3



INVENTORS
R. D. DODGE
L. E. PALMER

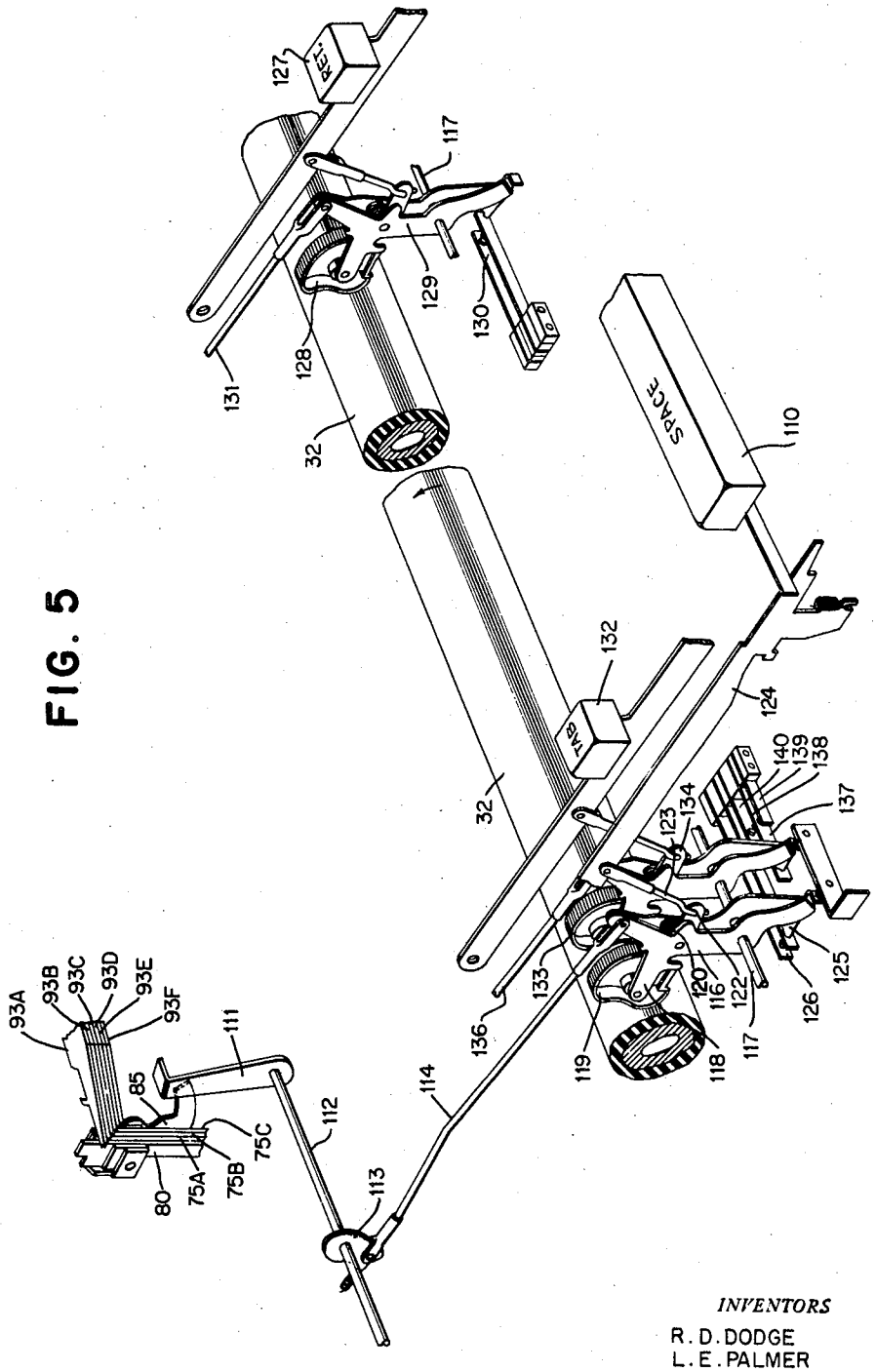
BY Murray Nanes
ATTORNEY

July 10, 1956 R. D. DODGE ET AL 2,753,973

JUSTIFIER FOR TYPEWRITERS

Filed March 12, 1953 9 Sheets-Sheet 4

FIG. 5



INVENTORS
R. D. DODGE
L. E. PALMER

BY Murray Naves
ATTORNEY

July 10, 1956 R. D. DODGE ET AL 2,753,973

JUSTIFIER FOR TYPEWRITERS

Filed March 12, 1953 9 Sheets-Sheet 5

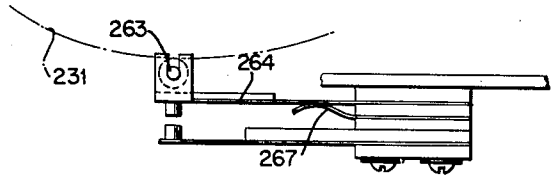


FIG. 15

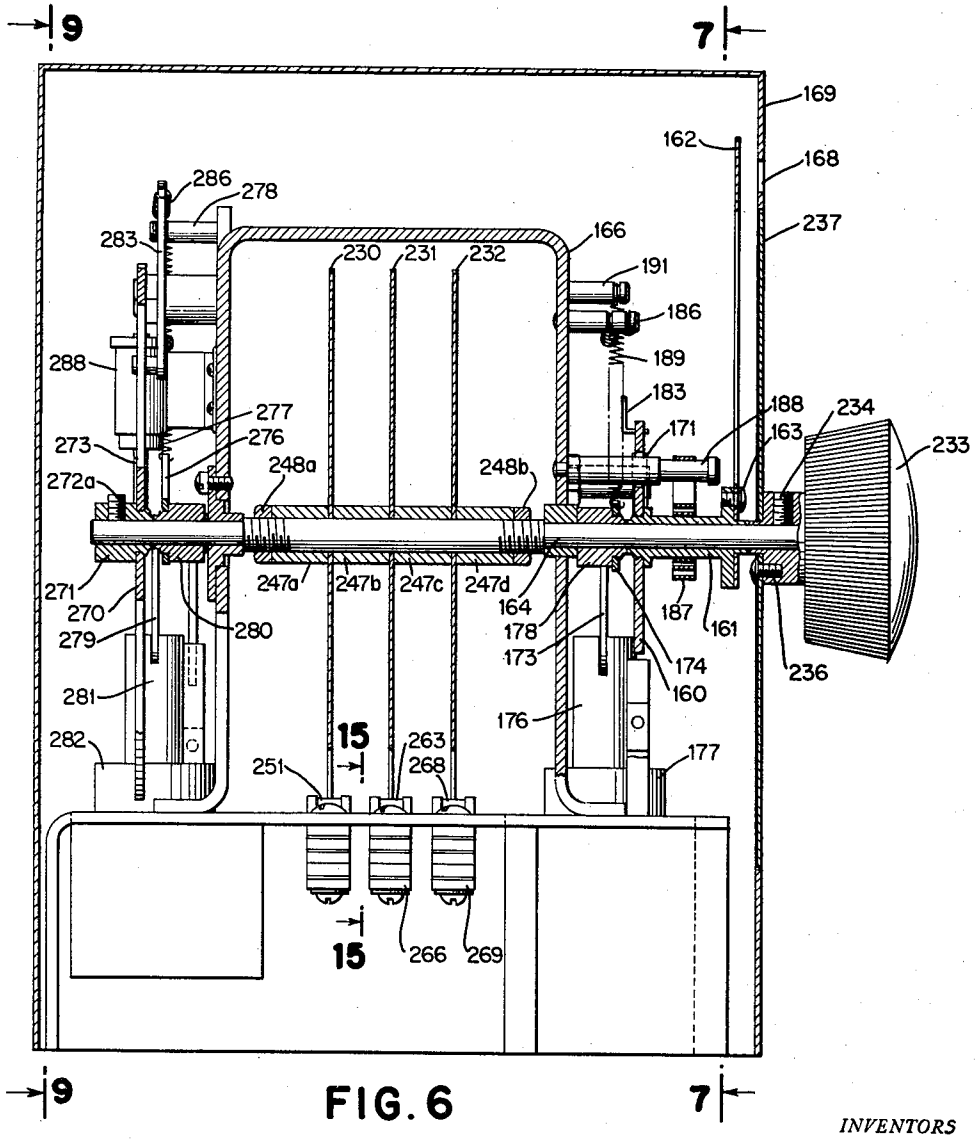


FIG. 6

INVENTORS

R. D. DODGE

L. E. PALMER

BY Murray Nanes

ATTORNEY

July 10, 1956 R. D. DODGE ET AL 2,753,973

JUSTIFIER FOR TYPEWRITERS

Filed March 12, 1953 9 Sheets-Sheet 6

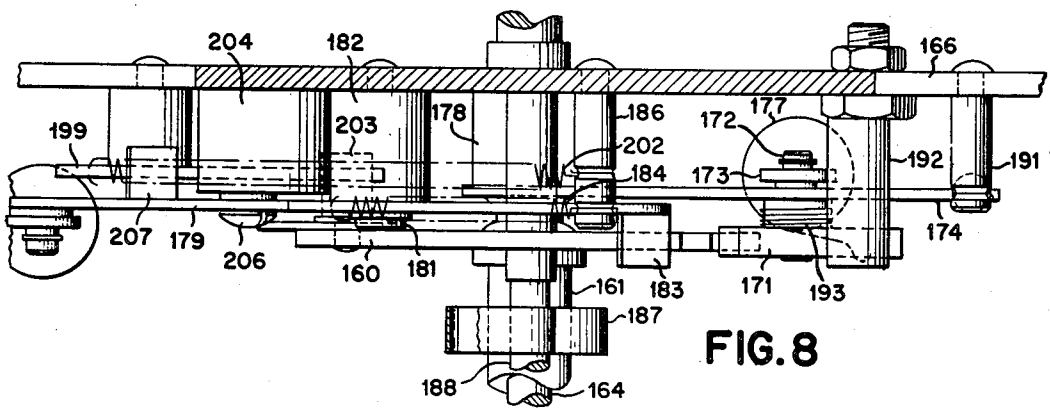


FIG. 8

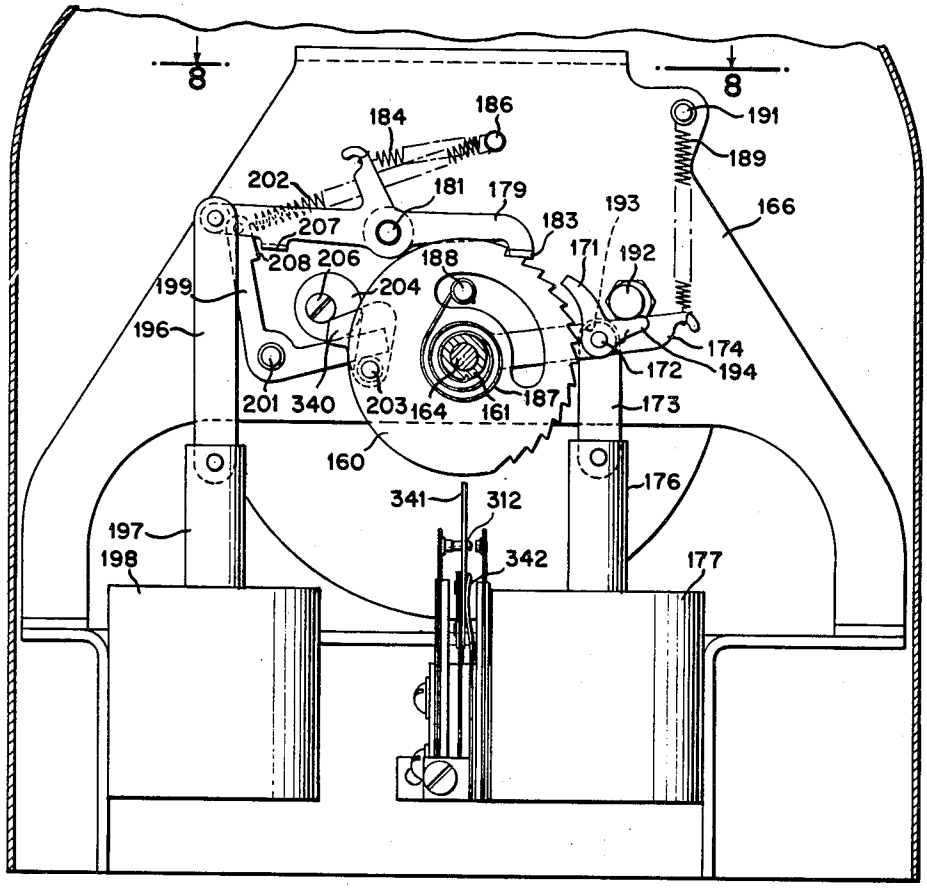


FIG. 7

INVENTORS
R. D. DODGE
L. E. PALMER

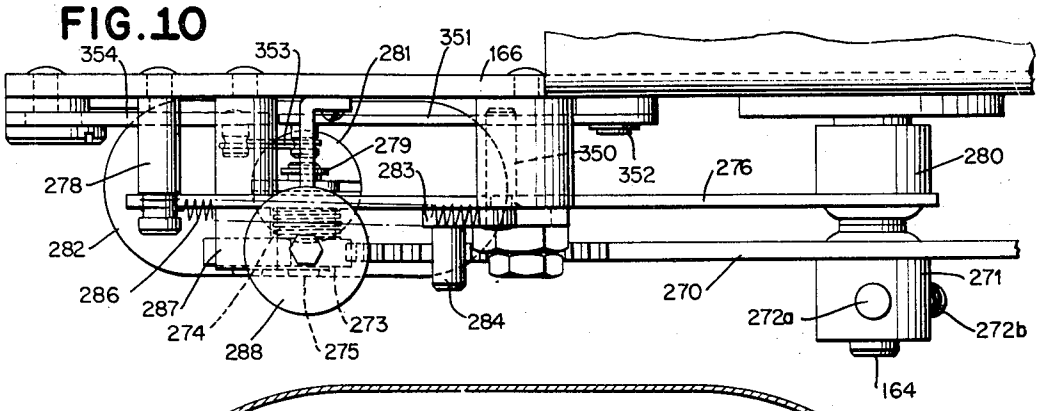
BY Murray Nanes
ATTORNEY

July 10, 1956 R. D. DODGE ET AL 2,753,973

JUSTIFIER FOR TYPEWRITERS

Filed March 12, 1953 9 Sheets-Sheet 7

FIG. 10



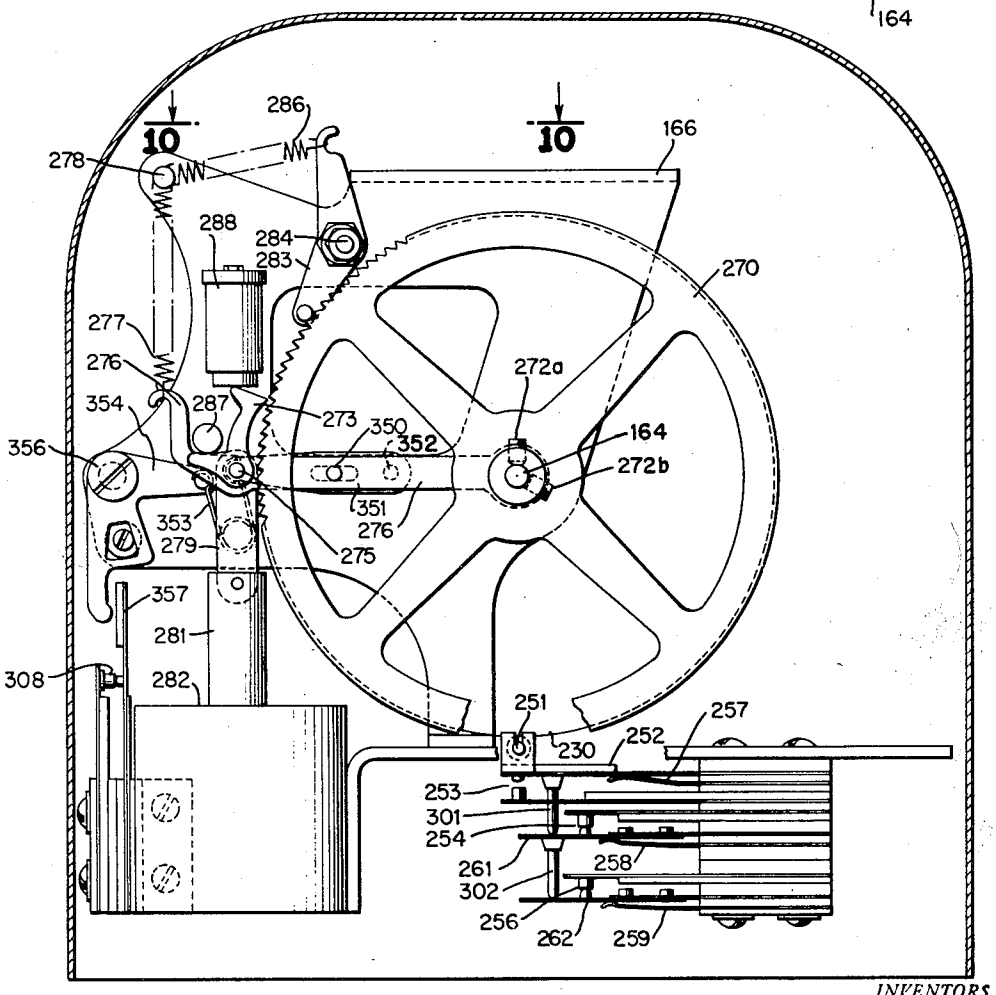


FIG. 9

INVENTORS
R. D. DODGE
L. E. PALMER

BY Murray Nanes
ATTORNEY

July 10, 1956 R. D. DODGE ET AL 2,753,973

JUSTIFIER FOR TYPEWRITERS

Filed March 12, 1953 9 Sheets-Sheet 8

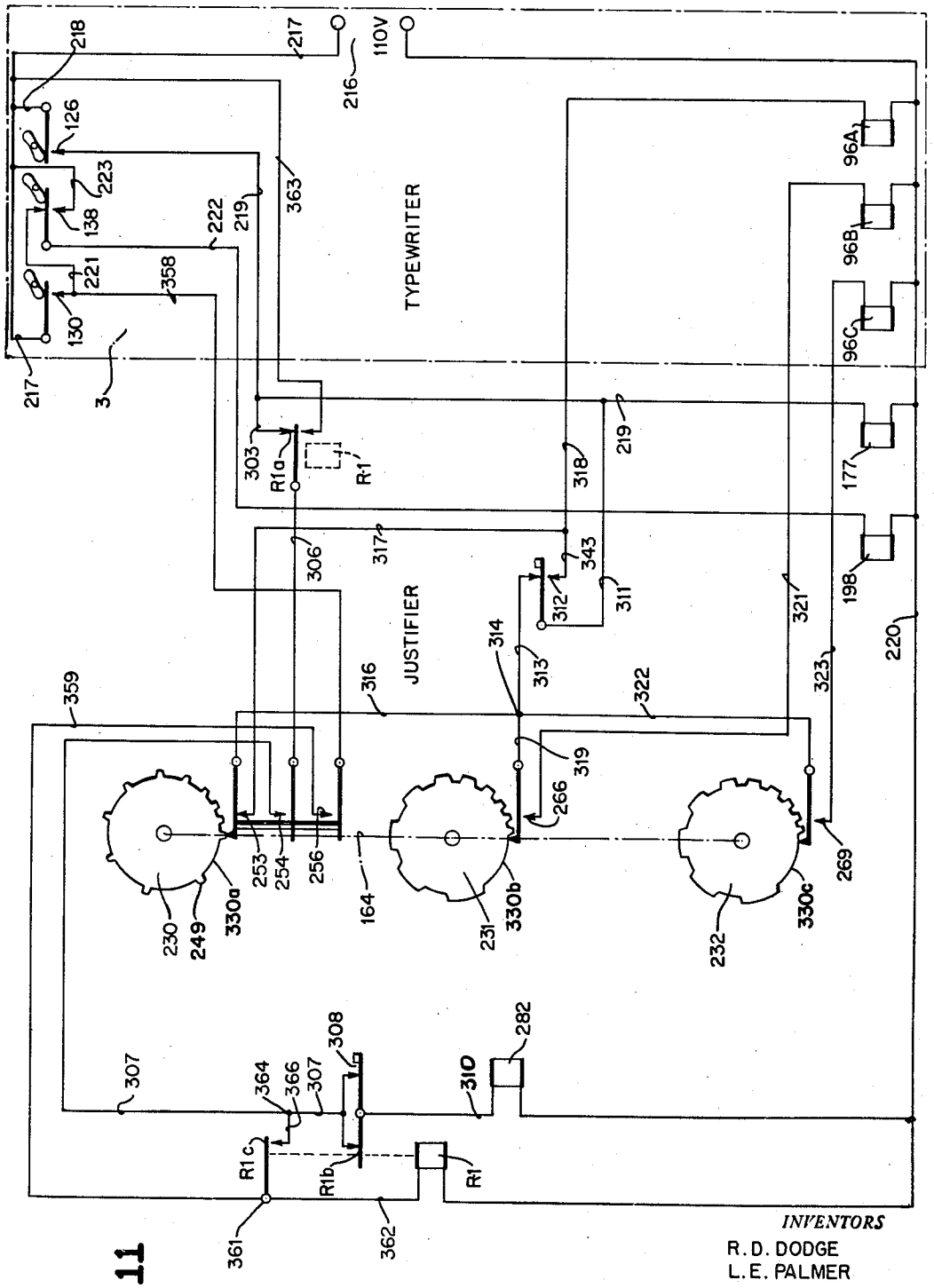


FIG. 11

INVENTORS
R. D. DODGE
L. E. PALMER

BY Murray Nanes
ATTORNEY

July 10, 1956 R. D. DODGE ET AL 2,753,973

JUSTIFIER FOR TYPEWRITERS

Filed March 12, 1953

9 Sheets-Sheet 9

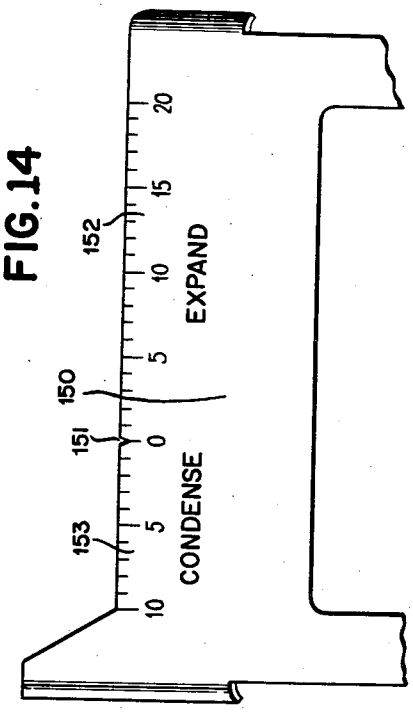


FIG. 14

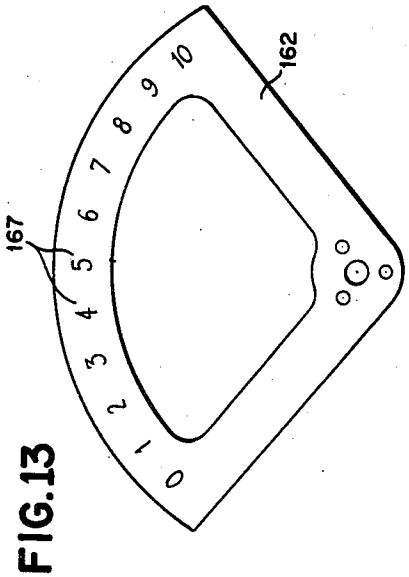


FIG. 13

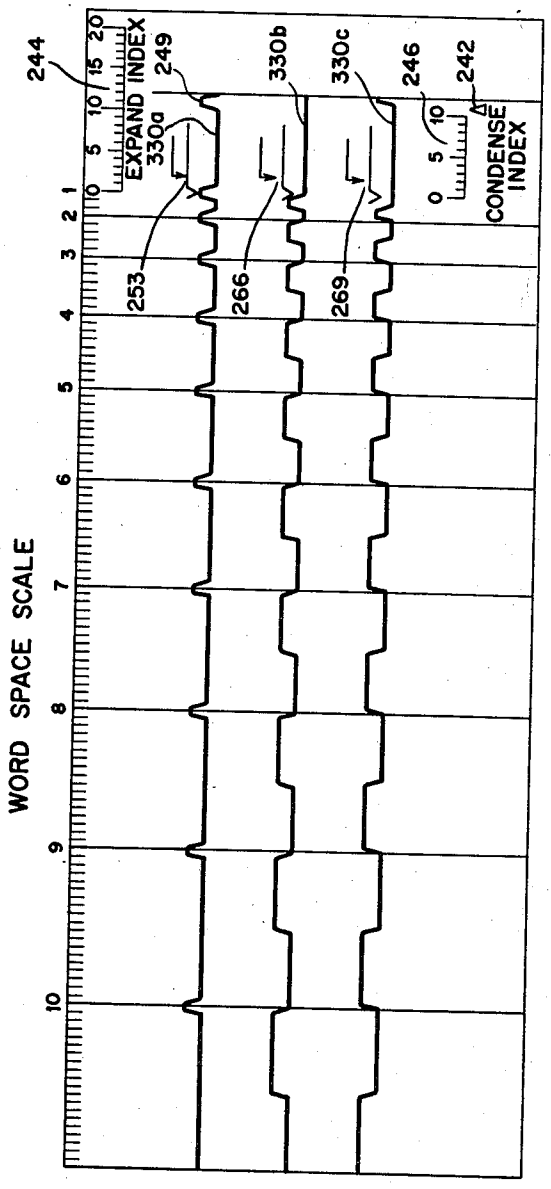


FIG. 12

INVENTORS
R. D. DODGE
L. E. PALMER

BY Murray Neuss
ATTORNEY

United States Patent Office 2,753,973 Patented July 10, 1956

2,753,973

JUSTIFIER FOR TYPEWRITERS

Ronald D. Dodge, Poughkeepsie, and Leon E. Palmer, Wappingers Falls, N. Y., assignors to International Business Machines Corporation, New York, N. Y., a corporation of New York

Application March 12, 1953, Serial No. 342,001

15 Claims. (Cl. 197—84)

This invention relates to justifying mechanisms, and more particularly to justifying mechanisms which are adapted for use with typewriters.

The principal object of the present invention is to provide an improved mechanism to be used in conjunction with a typewriter for justifying typewritten copy.

Another object is to provide an improved justifying mechanism which is capable of either expanding or condensing the length of each typed line to provide an even right hand margin.

Still another object is to provide a justifying mechanism which operates upon actuation of the space bar of a typewriter for varying the spaces between words of a line to the extent necessary to provide an even right hand margin without affecting the spacing between the characters of words.

Yet another object is to provide a justifying mechanism which is independent of the typewriter and which can readily be electrically connected interchangeably with any one of a group of similar typewriters.

Another object is to provide a justifying mechanism which is connected to a typewriter in such a way that the typewriter may be used independently of the justifying mechanism without any manipulation.

Still another object is to provide a justifying mechanism which can be selectively set by only one easily manipulated dial to expand or condense a type line.

Another object is to provide a justifying mechanism having a novel built-in counter which indicates the number of spaces between words in each typed line.

Yet another object is to provide a mechanism which is capable of varying the spacing between words in a typed line to obtain a desired expansion or contraction even when the number of words in the line are greater than the built-in capacity of the mechanism.

Another object is to provide for a typewriter, a justifying mechanism which is restored by the carriage return of the typewriter to an inactive position in readiness for typing with normal spacing between words.

Other objects of the invention will be pointed out in the following description and claims, and illustrated in the accompanying drawings, which disclose, by way of example, the principle of the invention and the best mode, which has been contemplated, of applying that principle.

In the drawings:

Fig. 1 is a perspective view of a typewriter having the improved justifier associated therewith.

Fig. 2 is a vertical sectional view of the typewriter, showing the type-bar actuating mechanism and carriage control means.

Fig. 3 is a perspective view showing the escapement selectors and variable spacing mechanism for the typewriter.

Fig. 4 is a large scale rear perspective view of the variable spacing mechanism.

Fig. 5 is a perspective view of the space bar mechanism and part of the carriage return and tabular mechanisms.

Fig. 6 is a vertical longitudinal sectional view of the justifier.

Fig. 7 is a vertical sectional view of the justifier taken on the line 7—7 of Fig. 6.

Fig. 8 is an enlarged horizontal sectional view taken on the line 8—8 in Fig. 7.

Fig. 9 is a vertical sectional view of the justifier taken on the line 9—9 in Fig. 6.

Fig. 10 is an enlarged horizontal sectional view taken on the line 10—10 in Fig. 9.

Fig. 11 is a schematic wiring diagram of the justifier mechanism.

Fig. 12 is a developed view of the circuit controlling cams.

Fig. 13 is a detail view of a word space counter dial.

Fig. 14 is a detail view of a unit space index.

Fig. 15 is a section taken on the line 15—15 of Fig. 6.

Referring to the drawings, and more particularly to Fig. 1, it will be noted that there is shown an improved justifier 1 electrically connected by a cable 2 to an electric typewriter 3. In Fig. 11, the wiring in the typewriter 3 is shown enclosed and the wires shown coming from the typewriter on the right to the justifier on the left constitute the cable 2. The typewriter 3 contains a proportional spacing mechanism which functions in substantially the same way as the mechanism disclosed in Patent No. 2,547,449 to select one or more of the escapement mechanisms for operation to space the carriage an extent depending upon the width of the character to be printed. The typewriter chosen to illustrate this invention can space either two, three, four or five units but it will be understood that the invention is not limited in its application with the specific machine selected for purposes of illustration but may be used in conjunction with other typewriters equally as well. Since the variable or proportional spacing typewriter is now well known in the art and is fully described in the above mentioned patent, only a very brief general description of the machine will be given such as will enable the present invention to be readily understood.

Type bar action

The numeral 10 (Figs. 2 and 3) designates one of the key levers of which there is one for each character printing type bar. The key lever 10 is pivoted on a cross rod 11 suitably supported in the side frames 12 of the machine. Each key lever 10 is provided with a finger button 13 and a restoring spring 14 which urges the key lever 10 in a counterclockwise direction (Fig. 2).

Associated with each key lever 10 is a character printing type bar 15 which, as usual in the art, may be provided with two types 16 comprising upper and lower case characters. The type bars 15 are supported in a type basket which includes the usual segment 17 and the type bars 15 are pivotally supported in the segment 17 by the usual curved pivot wire 18. The segment 17 is slotted to accommodate the type bars 15, and since the segment is curved, the type bars 15 recline at the angle shown in Fig. 2, but at different levels in the machine.

Each type bar 15 is operated by a power unit which includes a sub-lever 19 connected by a link 20 to an extension 15a formed on the associated type bar 15, whereby the rocking of the sub-lever 19 clockwise, through the link 20, actuates the type bars 15 in a counterclockwise direction to engage one or the other of the type characters 16 with the work sheet on the usual platen 21, the type striking through the usual ribbon, not shown.

The lower end of each sub-lever 19 is formed with a deep notch 22 which cooperates with a fulcrum strip 23 having a rounded nose 24 that is kept seated in the notch 22 by means of a spring 25 which is anchored to the lower end of the sub-lever 19 below the notch 22

and to a lug 26 on the fulcrum strip 23. The spring 25 not only serves to hold the sub-lever 19 on the pivot or nose 24 but also tends to restore the sub-lever 19 when it has been actuated as hereafter described and incidentally assists in restoring the type bar 15 after it has made its impression.

Each power unit includes a somewhat L-shaped cam element 27 pivoted at stud 28 on the sub-lever 19. This cam 27 is provided with a restoring spring 29 which is anchored to an ear 30 formed on the cam 27 and to a lug struck from the sub-lever 19. The cam 27 is provided with a spiral tread 31 designed to cooperate with the power roller 32 which rotates continually in the direction of the arrow (Fig. 2) while the machine is in use. Normally, however, the upper end of the tread 31 clears the power roller with the parts shown in the position of Fig. 2 which is the normal position.

Each cam 27 has an elongated tail piece 33 which ordinarily is held in engagement with a lug 34 on a release member 35, the spring 29 in the position of Fig. 2 holding the tail piece 33 against the lug 34. The release member 35 is provided with a slot through which passes a stud 36 carried by an arm forming part of the sub-lever 19. A spring 37, connected at one end to an ear 38 formed on the release member 35 and at the other end to a lug 39 formed on the arm of sub-lever 19, holds the member 35 with the stud 36 at the right-hand end of the slot and also normally holds the member 35 up against the lug 39. The member 35 has a lug 40 which just clears a short extension or lug 41 on the character key 10.

When the character key 10 is depressed, the member 35 is rocked slightly counterclockwise by the engagement of the lug 41 with the lug 40. This rocks the cam 27 clockwise sufficiently to bring the upper end of the tread 31 into engagement with the surface of the power roller 32. Thereafter, the power roller 32 drives the cam 27 in a clockwise direction and, due to the eccentric shape of the tread 31 on cam 27, pushes the stud 28 to the right in a short arcuate path, thereby actuating the sub-lever 19 in a clockwise direction on pivot 24, and through the link 20 operating the type bar 15 to effect an imprint from one of the types 16.

Escapement selectors and the variable spacing mechanism

A space selecting mechanism is provided which can either be operated by the power mechanism for the type bars or by the justifier. This mechanism is shown in Figs. 2 and 3 and is largely mounted underneath the keyboard just in front (to the right in Fig. 2), of the power roller 32. A cross shaft 50 is journalled in the side frames 12 (Fig. 3) underneath the front ends of the keys 10, and, adjacent the side frames 12, the shaft 50 is circumferentially grooved to vertically guide two support plates 51 in which are loosely pivotally supported selector bails 52A, 52B and 52C. Each bail consists of a round rod formed with cranks at its ends pivoted at 53 in the plates 51. The plates 51 are vertically guided at their lower ends by studs 54 carried by the side frames 12 so that the plates 51 are compelled to move vertically and linearly. Secured to the shaft 50 near its ends are two bell cranks 55 and 56, each of which has a pin 57 and 58, respectively, loose in a horizontal slot formed in one of the plates 51, and the bell crank 55 is connected by a link 59 to a lever 60 (Fig. 2) mounted on a shaft 61 loosely journalled in the frames 12. The shaft 61 forms part of the shift mechanism disclosed in Patent 2,517,989, granted August 8, 1950, and is rocked a limited extent clockwise (Fig. 2) each time type basket 17 is shifted downwardly to the upper case position. This causes both plates 51 to be elevated a limited extent thereby raising all of the bails 52A, 52B and 52C and changing the space selections in a manner to be presently described when upper case characters are printed, as some of the upper case characters are wider than the lower case characters and call for increased spacing.

At this point, it should be explained that a certain number of the characters in the font which may be employed require only two units of spacing and for this reason, the spacing mechanism and the selector mechanism are so designed that normally the typewriter will space two units unless three, four or five units are selected. Thus, for certain of the type bars 15, the selector bails 52A, 52B and 52C will not be operated but the spacing mechanism will nevertheless, be operated to effect two units of spacing. However, when the justifier is connected to the typewriter, electrical circuits are completed, as will be presently shown, which will normally cause the machine to space three units unless two, four or five units are selected. This is done to provide for a condensing action from the normal three unit spacing to two unit spacing, or for an expanding action to four and five unit spacing.

For the purpose of operating the bails 52A, 52B and 52C to select three, four or five units of spacing between characters, there is provided a series of selector bars 65 (Figs. 2 and 3) which are pivoted at 66 to the sub-levers 19 whereby the bar 65 will be drawn to the left each time the corresponding type bar 15 is operated in the manner explained above. The selector bars 65 are guided at their front or right hand ends (Fig. 2) by a cross bar 67 so that their motion is substantially horizontal. These selector bars 65 are provided with various combinations of lugs like 68A and 68B, or none at all, adjacent the bails 52A, 52B and 52C whereby the bails are rocked clockwise selectively.

The selector bar 65 in Fig. 3 is typical of a character which is to have three units of spacing in the lower case and four units of spacing in the upper case. Accordingly, the lug 68A is so shaped as to move the bail 52A rearwardly each time the bar 65 is operated, whereas the lug 68B is so shaped as to move the bail 52B rearwardly when the plates 51 are elevated as is the case when the type basket is shifted to upper case position, but, under the last condition, the bail 52A will clear the lug 68A.

Associated with the bails 52A, 52B and 52C are arms 70A, 70B and 70C connected by links 71A, 71B and 71C to bell cranks 72A, 72B and 72C journalled on a fixed pivot 73. The letters A, B, and C are associated with the parts which effect the selections of three, four and five units of spacing, respectively. The bell cranks 72A, 72B and 72C have forked connections 74A, 74B and 74C (Figs. 2 and 3) to interposers 75A, 75B and 75C which are pivotally slidably mounted on a fixed stud 76. The stud 76 also supports a fourth interposer 80 (Figs. 3, 4 and 5) which is taller than interposers 75A, 75B and 75C but this interposer 80 is not vertically slidable on the stud 76. Operating the bail 52A will rock the bell crank 72A and raise the interposer 75A to the height of the interposer 80. Operating bails 52B and 52C will raise the interposers 75B and 75C, respectively, to the height of the interposer 80.

The interposer 80 is pivoted on the stud 76 with a very loose fit so that its upper end may be swung forwardly in Fig. 3 (rearwardly in Fig. 4) for a purpose to be made clear presently. The interposers 75A, 75B, 75C and 80 are mounted within a cage 83 which keeps the interposers in intimate contact with each other while permitting them to slide vertically, with the exception of the interposer 80. This cage 83 is loosely mounted on the stud 76 so that the cage and the interposers 75A, 75B, 75C and 80 all swing bodily on the stud 76.

Pivotally mounted on a fixed stud 84 is a common operating member 85 which partly encloses the interposers 75A, 75B, 75C and 80 and has a link connection 86 to the universal bar 87. This universal bar 87 is pushed to the left (Fig. 2) each time a type bar is operated thereby rocking the common operating member 85 clockwise (Fig. 2) on its pivot 84. This same operation shows up in Fig. 3 as a forward motion of the top 85A of the common operating member 85, and in Fig. 4 as a rearward

motion of the top 85A. In rocking, the top 85A acts to effect a rocking of interposer 80 and any other interposer 75A, 75B and 75C which might be raised at the time. With the interposers 75A, 75B and 75C in their lower positions (Fig. 2) the top 85A of the operating member does not engage them when rocked in a clockwise direction. The stud 84 serves to limit counterclockwise swinging movement of the interposers 75A, 75B, 75C and 80. These interposers are urged in a counterclockwise direction (Fig. 2) by means of springs 88 which also tend to draw down the interposers, and the bell cranks 72A, 72B and 72C are provided with coil springs 89 which urge the levers in a counterclockwise direction against a fixed stop lug 90 carried by the framework.

The interposers 75A, 75B, 75C and 80 cooperate with escapement pawls 93A, 93B, 93C, 93D, 93E and 93F which engage an escapement rack 94 (Figs. 2 and 4) secured in any suitable manner to the bottom of the channel shaped member 95 which forms part of the carriage of the typewriter. The escapement pawls 93A to 93F are selectively operated by the interposers 75A, 75B, 75C and 80 to effect proportional spacing of the carriage in a manner thoroughly disclosed in Patent 2,547,449. For the purpose of understanding the present invention, it is only necessary to know that when interposer 80 is rocked, it operates the pawls 93A to 93F to feed the carriage two unit spaces, and when interposers 75A, 75B and 75C are rocked, three, four and five unit spacing, respectively, is effected.

It can thus be understood that depressing a character key 13 that has no lugs like 68A and 68B on its selector bar 65 and does not select one of the bails 52A, 52B and 52C, will nevertheless cause an operation of the universal bar 87 to push the link 86 for rocking the common operating member 85. Even though none of the interposers 75A, 75B or 75C have been raised, interposer 80 is high enough so that it will be rocked to engage the escapement pawls 93A through 93F and give two unit spacing.

One method has just been described for selectively operating the bails 52A, 52B and 52C by means of a series of selector bars 65 which are operated each time a character key 10 is depressed. For the purpose of performing justification, three electromagnets or solenoids 96A, 96B and 96C (Figs. 3 and 11) have been provided for operating the bails 52A, 52B and 52C between words in a manner to be described later. A plunger arm 97A of the solenoid 96A is connected by a link 98A to an arm 99A associated with bail 52A. Energizing solenoid 96A will pull arm 99A and rock bail 52A which, as has been previously described, effects a raising of interposer 75A into the path of the common operating member 85 to give three unit spacing. The means for rocking the common operating member 85 between words will be presently described. With the bails 52B and 52C there is associated a similar series of parts designated 96B, 97B, 98B and 99B and 96C, 97C, 98C, and 99C respectively, the letters A, B and C once again being associated with the parts which effect the selection of three, four or five units of spacing respectively.

Word spacing, carriage return and tabulation

A means has been described for actuating the common operating member 85 from the universal bar 87 to get proportional spacing between characters of a word. It is desirable that means be provided to actuate the common operating member 85 for selectively spacing the carriage between words, and for this purpose the typewriter is equipped with a space bar 110 (Figs. 1 and 5). Cooperating with the member 85 is an arm 111 connected to one end of a rod 112 which is rotatably supported by any stationary means, not shown. Fixed to the rod 112 is a lever 113 that is connected by a link 114 to a sublever 116 which is loosely mounted on a rod 117 supported by the framework in any suitable manner. An arm 118 of the sub-lever 116 carries a cam 119 which is urged by a spring 120 toward engagement with the continuously rotating power roller 32. Pivotally mounted on the sub-lever 116 is a member 122 for holding the cam 119 normally free of the power roll, and this member is connected by a link 123 to a lever 124 which cooperates with the space bar 110. At the lower end of the sub-lever 116 is an ear 125 which cooperates with word space contacts 126 for closing the latter upon depression of the space bar. The cam control mechanism is similar to that disclosed in Patent No. 2,517,989 and needs no further description at this time.

When the space bar 110 is depressed, the link 123 operates the member 122 for releasing the cam so that it engages the power roller and is actuated thereby to rock the sub-lever 116 clockwise about the rod 117 for closing the contacts 126 and effecting a forward movement of the link 114. The closing of contacts 126 energize circuits which will be described later. The forward movement of the link 114 rocks the lever 113, the rod 112 and the arm 111 in a direction to engage the latter with the common operating member 85 for rocking its upper end toward the interposers. In rocking, the top 85A of the common operating member 85 (Fig. 2) acts to effect a rocking of interposer 80 and any other interposer 75A, 75B and 75C which might be raised at the time by the energization of solenoids 96A, 96B and 96C, resulting in variable spacing between words.

It is desirable in a typewriter to be able to return the carriage at the end of a line and to perform a tabulating operation. Carriage return is accomplished by depressing a carriage return key 127 (Fig. 5) to cause a cam 128 to be operated by the power roller 32 for rocking a sub-lever 129 clockwise. The clockwise rocking of sub-lever 129 closes contacts 130 and pulls a link 131 forward. Link 131 operates a carriage return mechanism which is well known in the art and which will not be described in the present case because its specific construction is not a feature of the invention claimed hereinafter.

Tabulation is accomplished by depressing a tab key 132 to cause a cam 133 to be operated by the power roller 32 for rocking a sub-lever 134 clockwise and pulling forward on a link 136. Link 136 operates a tabular mechanism which is also well known in the art and will not be described herein. The clockwise rocking of sub-lever 134 causes a transfer arm 137 of a transfer switch 138 (Figs. 5 and 11) to move from a position in contact with a contact arm 139 to a position in contact with a contact arm 140. The closing of contacts 130 and the shifting of the transfer switch 138 completes circuits which will be described later.

Justifying indicator

In order to produce a justified typewritten sheet, it is desirable to first type the material in draft form. As each line is completed in typing the draft, the operator first notes how many units of spacing the line is short of or beyond the length desired and then notes the number of words in the line. The draft copy thus obtained is now retyped on a new sheet of paper. Before retyping each line, the operator sets the justifier mechanism from the information noted on the draft copy and types the line in the normal way. The justifier automatically operates in a manner to be presently explained for expanding or condensing the line to the length desired. If the typewriter has a long carriage, the need for the operator to stop and note the required information on the rough draft is avoided. In this case, the rough draft is placed to the left on the carriage and the new sheet of paper to the right. After a trial line is typed, the operator obtains the required information and sets the justifier mechanism accordingly. The operator then actuates the tab key 132, which is set to move the new sheet into the typing position, and retypes the line.

To determine how many units of spacing the trial line is short of or beyond the length desired, provision is

made for a unit space index **150** (Figs. 1 and 14) on the carriage of the typewriter. The unit space index contains a notch **151**, between an expand scale **152** and a condense scale **153**. The expand and condense scales **152** and **153** are divided into 20 and 10 units respectively, the width of each unit corresponding to one unit of spacing of the typewriter. It should be kept in mind that the typewriter spaces 2, 3, 4 and 5 unit spaces only.

A rough draft sheet of paper is placed in the carriage in a well known manner and the carriage is positioned so that the place selected for the right hand margin on the paper is at the typing position **154** (Fig. 1). A pencil is held in the notch **151** and the platen **21** is rotated to provide an accurate vertical line, known as a justifying line, extending from top to bottom of the rough draft sheet. Each time a line is typed, it should be terminated with the justifying line as close to the notch **151** as possible. The justifying line will then indicate on the scales **152** or **153** whether an expanding or condensing action is to take place and the number of unit spaces to be added or subtracted from the trial line to provide for an even righthand margin.

Word space counter

As has been previously explained, the operator must make a reading of the number of word spaces in the trial line. This reading is necessary because in this invention, justification is effected by varying only the spaces between words. During the spacing operations between words, as a consequence of the depression of the space bar **110**, the justifying mechanism automatically operates to vary the spacing between words, in a manner to be presently described, by selectively controlling the variable escapement mechanism. A novel word space counter which is provided for counting the number of word spaces in a line will now be described.

A ratchet **160** (Figs. 6, 7, and 8) is attached to a sleeve **161** to which a word space counter dial **162** (Figs. 6 and 13) is connected by set screws **163**. The unit comprising the dial **162**, ratchet **160** and sleeve **161** is free to rotate on a shaft **164** which is rotatably supported by a frame **166**.

Printed numbers **167** (Fig. 13) on the face of the word space counter dial **162** indicate the number of spaces between words in the trial line. The numbers **167** can be read through a window **168** (Figs. 1 and 6) in a casing **169**. It should be noted at this point that provision is only made for the counting of 10 word spaces (11 words) in a line. The situation where there are more than 10 word spaces in a line will be discussed later.

Cooperating with the ratchet **160**, as shown in Fig. 7, is a stepping pawl **171** which is rotatably connected by a pin **172** to a link **173** and a lever **174**. The link **173** is connected to a plunger arm **176** of a solenoid **177** (Fig. 7), and the lever **174** is attached to a hub **178** (Fig. 6) which is free to rotate on the shaft **164**. Acting in conjunction with the stepping pawl **171** is a detent **179** which is pivoted on a stud **181** mounted on a cylindrical block **182** (Fig. 8) fixed to the frame **166**. An ear **183** on the detent **179** is normally held in engagement with the teeth of the ratchet **160** by a spring **184** anchored to a stud **186** on the frame **166**. Surrounding the sleeve **161** is a torsion spring **187** anchored at one end to a stud **188** supported by the frame **166**, and attached at its other end to the sleeve **161** for urging the ratchet **160** in a clockwise direction.

The energizing of solenoid **177** in a manner to be presently described, effects a lowering of the stepping pawl **171** and a swinging of the lever **174** downwarly against the action of a spring **189** which is fastened to one end of the lever **174** and is anchored to a stud **191** mounted on the frame **166**.

Movement of the ratchet **160** and its accompanying space counter dial **162** is effected when the solenoid **177** is deenergized. This permits the spring **189** to lift the lever **174** and the stepping pawl **171** until the lever engages a stop **192**. The stepping pawl **171** is urged counterclockwise by a torsion spring **193** so that it engages a tooth of the ratchet **160** and rotates the latter counterclockwise one step. As the lever **174** approaches the upper limit of its movement, a tail portion **194** of the stepping pawl **171** engages the stop **192** and effects a releasing of the pawl **171** from the ratchet **160**. The detent **179** normally cooperates with the ratchet **160** for holding it against rotation by the spring **187** when the pawl **171** is disengaged.

The solenoid **177** is energized, as described later, only during the spacing of the typewriter carriage between words. After a trial line has been typed, the operator observes through the window **168** the number on the dial indicating the word spaces in the trial line. In order to release the ratchet so that the dial is returned to its home position by the spring **187**, the detent **179** is connected through a link **196** to a plunger arm **197** of a solenoid **198** (Fig. 7). Cooperating with the detent **179** is a latch **199** which is pivoted at a fixed pin **201** and is pulled in clockwise direction by a spring **202** anchored to the stud **186**. Cooperating with the latch **199** is a pin **203** protruding from the ratchet **160**, and a cylindrical stop **204** fastened to the frame **166** by a screw **206**.

The energizing of the solenoid **198** in a manner to be presently described effects a lowering of the link **196** for rocking the detent **179** around the pivot **181** and thereby disengaging the detent ear **183** from the tooth of the ratchet **160**. This releases the ratchet **160** and permits the torsion spring **187** to effect a clockwise resetting of the ratchet **160** and the word space counter dial **162**. Since a premature deenergizing of the solenoid **198** would cause partial resetting, the detent is held counterclockwise by the engagement of a detent ear **207** with the latch **199** at notch **208**. When the word space counter dial has rotated to its zero position, the pin **203** strikes the arm of latch **199** and pushes it up against the stop **204**. This releases the latch from the detent so that the latter engages the ratchet **160** again in its zero position.

The energizing of solenoid **177** is accomplished by actuating the space bar **110** on the typewriter to effect a closing of the word space contacts **126** as previously described. This completes a circuit (Fig. 11) from one side of the 110 volt line **216** through wire **217**, wire **218**, the closed word space contacts **126**, wire **219** and the solenoid **177** to wire **220** and the other side of the 110 volt line **216**.

Solenoid **198** is energized at the end of a typed line by actuating the carriage return key **127** on the typewriter to effect a closing of the carriage return contacts **130** as previously described. This completes a circuit, from one side of the 110 volt line **216** through wire **217**, the closed carriage return contacts **130**, through wire **221**, the normally closed tab transfer switch **138**, wire **222**, solenoid **198** and back to wire **220** and the other side of the 110 volt line **216**. The solenoid **198** may also be energized by pressing the tab key **132** on the typewriter to effect a closing of the normally open tab transfer switch **138** as previously described. This completes a circuit from one side of the 110 volt line **216** through wire **217**, wire **223**, normally open tab transfer switch **138**, wire **222** and solenoid **198** to wire **220** and the other side of the 110 volt line **216**.

To summarize the operation of the word space counter, it can be understood that in typing the trial line, the counter dial **162** is advanced step by step by the actuation of the space bar **110**, thereby counting the word spaces. The counter dial **162** is then reset at the end of the line by actuating the carriage return key. In a long carriage typewriter, as has been previously described, the operator may actuate the tab key **132** to move from the rough draft to the new sheet and, in that case, the tab key **132** acts to reset the counter dial **162**. The reason for resetting the counter dial **162** in a tabular operation will be discussed more fully later.

Selector mechanism

Selector cams **230, 231** and **232** (Figs. 6, 11 and 12) are provided to control, in a manner to be presently described, the energizing of the solenoids **96A, 96B** and **96C** (Fig. 3) which position the interposers, as described above, to determine movement of the typewriter carriage between words. If a trial line is typed an extent short of the right hand margin, the cams are set so as to energize the solenoids for effecting an increased spacing between some or all of the words, or the spacing may progressively decrease and become a constant three unit spacing as the typing of the line proceeds. In condensing, the escapement mechanism is operated to cause a decreased spacing between some or all of the words, or the spacing may increase and become a constant three unit spacing towards the end of the line. Thus, if there is an even number of spaces in a line but the shortage or overage is odd or does not divide evenly, the first few spaces between words will be greater or lesser than the last few, unless the values are such that it is possible to divide the increased or decreased spacing equally among the word spaces.

A knob **233** (Figs. 1 and 6) is fastened by a screw **234** to the shaft **164**. A set screw **236** holds a main dial **237** (Figs. 1 and 6) fastened to the knob **233**. The main dial **237** contains ten numerals, known as the word space scale **239**, representative of the number of word spaces in the line, and formed on the dial is a triangular indicator **242**. The word space scale **239** is used in expand operations, and the triangular indicator **242** is used in condense operations. The face plate **169** at the front of the justifier **1** contains an expand index **244** and a condense index **246**. The expand index **244** is divided into twenty units denoting the number of unit spaces to be expanded, and the condense index **246** is divided into ten units denoting the number of unit spaces to be condensed.

The cams **230, 231** and **232** are operable to effect movement of the carriage three, four and five space units, respectively. These cams are equally spaced on the shaft **164** by four spacer sleeves **247*a***, **247*b***, **247*c***, and **247*d***, and the unit comprising the cams and sleeves are held tightly together and fastened to the shaft **164** by nuts **248*a*** and **248*b*** threaded on the shaft **164**. Rotating the shaft **164** acts to turn all three cams **230, 231** and **232** as a unit.

The three unit selector cam **230** carries eleven high dwells of widths representative of one unit of spacing. Ten of the high dwells are used in expanding, and high dwell **249** is used for condensing. The ten expanding high dwells are spaced at progressively increasing distances from a minimum of three units width between the first and second dwells and increasing in steps of two units to a maximum of nineteen units width between the ninth and tenth dwell.

The four unit selector cam **231** and the five unit selector cam **232** are used only in expanding and they each carry ten high dwells of progressively greater widths, from a width of one unit for the first dwell to ten units width for the tenth dwell.

The high dwells on cams **230, 231** and **232** are offset from each other as can be seen in Figs. 11 and 12, so that only one dwell of the three cams can be active at any one time to cooperate with contacts which will now be described.

Cooperating with the three unit selector cam **230** is a lug **251** (Figs. 6 and 9) which is attached to a transfer arm **252** of a set of contacts **253**. Stacked under contacts **253** are contacts **254** and **256**. Contacts **253** are normally held open by the action of leaf spring **257** against transfer arm **252**, while contacts **254** and **256** are normally held closed by the action of leaf springs **258** and **259** against transfer arms **261** and **262** of contacts **254** and **256**, respectively.

Cooperating with the four unit selector cam **231** is a lug **263** (Figs. 6 and 15) which is attached to a transfer arm **264** of a set of contacts **266**. Contacts **266** are normally held open by the action of leaf spring **267** against transfer arm **264**. The five unit selector cam **232** acts on a lug **268** (Fig. 6) which operates a normally open set of contacts **269** similar to contacts **266**.

The cams **230, 231** and **232** are arranged upon the shaft **164** so that the high dwells of the cams are located, with respect to the numbers of the word space scale, in the positions shown in Fig. 12. It will be noted that the high dwells of cam **230** are in line with the numbers of the scale while the high dwells on cams **231** are located so that their right hand edges are in line with the left hand edges of the dwells of cam **230**. The cam **232** is arranged so that the right hand edges of its high dwells are in line with the left hand edges of the dwells on cam **231**.

Since the word space scale is formed on the dial **237** which is fixed to rotate with the cams, then a positioning of the dial so that any one of the numbers on its scale is in line with the zero point on the expand index results in a positioning of cam **230** so that one of its high dwells closes the contacts **253**. When any one of the numbers on the word space scale is positioned in line with the No. 1 on the expand index, then the high dwell on cam **230** for that number is located one space unit to the right of contacts **253** so that the latter are open, and a high dwell on cam **231** is in a position to close the contacts **266**. This establishes a circuit to be described later, for expanding the first spacing between two words by one unit. As the first word spacing operation takes place by an actuation of the space bar, the cams are caused to rotate so that their high dwells move one unit space to the left in Fig. 12. This causes the contacts **253** to be closed and the contacts **266** to be opened. No further rotation of the cams will take place upon actuating the space bar **110**, and the carriage escapement resulting from an actuation of the space bar after the first will be equal to three units.

When the dial **237** is positioned so that the high dwells of cam **232** close the contacts **269**, then a spacing of five units is obtained between words upon actuating the space bar, and the cams are rotated one step with each actuation until the contacts **269** open and the contacts **266** close. Four units of spacing between words is then obtained by actuating the space bar and the cams continue stepping to the left in Fig. 12 until a high dwell on cam **230** closes the contacts **253**. A stepping of the cams to the left then stops and the spacing between words is equal to three units.

For stepping the cams and the dial **237** to different positions, a ratchet wheel **270** (Figs. 6, 9 and 10) is fastened to a hub **271** attached to the shaft **164** by screws **272*a*** and **272*b***. The unit comprising the ratchet wheel **270**, the cams **230, 231** and **232**, and the main dial **237** hereafter referred to as the cam assembly, can be set manually by rotating the knob **233**.

Cooperating with the ratchet wheel **270** is a stepping pawl **273** which is urged clockwise (Fig. 9) by a spring **274** and which is connected by a pin **275** to a lever **276**. The lever **276** is connected at one end to a hub **280** (Figs. 6 and 10) loosely mounted on the shaft **164** and connected at its other end to a spring **277** which is anchored to a fixed stud **278**. Also pivotally connected to the pin **275** is a link **279** which is connected to a plunger **281** of an advancing solenoid **282**. Acting in conjunction with the stepping pawl **273** is a detent **283** which is pivoted on fixed stud **284** and is normally held in engagement with the teeth of the ratchet wheel **270** by a spring **286** anchored to the stud **278**.

The energizing of solenoid **282** in a manner described later effects a lowering of the stepping pawl **273** and the lever **276** against the action of the spring **277**. Movement of the ratchet wheel **270** and the rest of the cam assembly is effected when the solenoid **282** is deenergized. This permits the spring **277** to raise the lever **276** and the stepping pawl **273** which in turn engages the ratchet wheel

270 and rotates it counter-clockwise (clockwise in Fig. 9). In contact with the stepping pawl 273 is a pneumatic stop 288 which acts in a well known manner to prevent the pawl 273 from building up too much momentum in its upward stroke and limits the rotation of the ratchet wheel 270 to only one step at a time. The detent 283, which has advanced to the next tooth, holds the ratchet wheel 270 in the new position.

To permit manual setting of the ratchet wheel 270 and the main dial 237 without interference from the stepping pawl 273, a stop 287 normally engages the stepping pawl 273 and holds it free of the ratchet. The upward motion of the lever 276 is also limited by the stop 287.

Expanding operation

In order to understand how the cams 230, 231 and 232 effect a justifying action, an expand operation will be explained. It must first be understood that in an expansion operation, the dial 237 is set manually by the operator according to information obtained from the indicator and word space counter. The numeral on the word space scale 239 representative of the number of word spaces in the trial line is set opposite the number on the expand index 244 indicating the number of unit spaces to be expanded. As the line is retyped, actuation of the word space bar 110 is effective to energize and de-energize the solenoid 282 for advancing the ratchet 270 one step at a time. The dial 237 turns with the ratchet wheel in a manner previously explained, so that the numeral on the word space scale 239 moves toward the "0" on the expand index 244. When the numeral is on this "0" position (known as the home position), no further rotation takes place. There is a home position for each numeral on the word space scale 239. When the word space scale 239 is at a home position, one of the high dwells of the three unit selector cam 230 acts to close the contacts 253 and to open the contacts 254 and 256. The closing of contacts 253 closes a circuit which effects three unit spacing in the home position while the opening of contacts 254 opens a circuit to stop any further rotation of the cam assembly.

In Fig. 11, a circuit can be traced for energizing the advancing solenoid 282 when the word space contact 126 is closed by an actuation of the space bar 110 and the cam 230 is in a position to close contacts 254. The circuit proceeds from one side of the 110 volt line 216, through wire 217, wire 218, the word space contact 126, wire 219, wire 303, normally closed contacts R1*a* of a restore relay R1, wire 306, contacts 254, wire 307, through either contacts 308 or restore contacts R1*b*, wire 310, advancing solenoid 282 and back to the other side of the 110 volt line 216. Restore contacts R1*a* and R1*b*, and contacts 308 will be described in more detail later but, to understand the operation of this circuit, it is only necessary to know that these contacts are normally in the positions shown in Fig. 11. It can then be observed that with contacts 254 closed, a closing of the word space contacts 126 will cause the cam assembly to advance one tooth, and when the home position is reached, contacts 254 open and stop any further advancement.

The circuits for selecting the spacing will now be described. Actuation of the space bar 110, when a high dwell on came 230 closes contacts 253, results in the completion of a circuit from one side of the 110 volt line 216 through wire 217, wire 218, the word space contacts 126, wire 219, wire 311, the normally closed side of a limit switch 312, wire 313 to point 314. From point 314, a circuit can be completed through wire 316, contacts 253, wire 317, wire 318 and solenoid 96A to the other side of the 110 volt line 216. This is the circuit for energizing solenoid 96A to give three unit spacing between words in a manner previously described. The cams 230, 231 and 232 are not shifted to new positions upon actuation of the space bar because the contacts 254 are held open and prevent the energizing of the solenoid 282 which actuates the ratchet 270.

The circuit for energizing solenoid 96B and giving four unit spacing between words is completed when the cam 231 is in a position to close the contacts 266. At this time, the cam 230 is in such a position that the contacts 253 are open and the contacts 254 are closed, and the cam 232 is in such a position that the contacts 269 are open. The circuit through the solenoid 96B can be traced from one side of the 110 volt line 216 to point 314 as in the previous circuit and from there through wire 319, contacts 266, wire 321 and solenoid 96B to the other side of the 110 volt line 216. It will be appreciated that an energizing of this circuit by the closing of contacts 126 through operation of the space bar also results in the energizing of the solenoid 282 since the contacts 254 are closed. This causes all of the cams to be turned one step in a counterclockwise direction in Fig. 11.

The circuit for energizing solenoid 96C and giving five unit spacing between words is completed when the cams are in such positions that the contacts 269 are closed, the contacts 266 and 253 are open, and the contacts 254 are closed. The circuit through the solenoid 96C can be traced from point 314 through wire 322, contact 269, wire 323, solenoid 96C to the other side of the 110 volt line 216. An energizing of this circuit by operation of the space bar also results in an energizing of the solenoid 282 for stepping the cams to a new position.

A word spacing of four unit spaces adds one unit space to the normal three unit word space. A word spacing of five unit spaces adds two unit spaces to the normal three unit word space. For example, if it is determined from the word space counter that there are six word spaces in the trial line, and from the justifier indicator 150 that the trial line is to be expanded three unit spaces, the "6" on the word space scale 239 is moved opposite the "3" on the expand index 244. In Fig. 12, this movement shows up as a shifting to the right of the cams 230, 231 and 232 to the position where the sixth high dwell on the cam 230 has moved three units past the contacts 253. It can be seen that in this position, contact 266 is closed by the high dwell of the four units cam 231 and remains closed until the cam assembly is advanced three steps to the left. Each actuation of the space bar 110 will give four unit spacing by energizing solenoid 96B, and will rotate the cams counterclockwise one step since the cam 230 permits contacts 254 to close for energizing the avancing solenoid 282. The high dwell on the four units cam 231 holds contacts 266 closed for three word spaces, at which time the cam 230 reaches a position for closing the contacts 253 and opening the contacts 254, and the cam 231 reaches a position at which the contacts 266 open. This results in three unit spacing until the end of the line since the advancing solenoid 282 is no longer energized. The entire operation results in making the new line three unit spaces longer than the trial line. If it had been desired to expand the line by eight unit spaces, then the dial 237 would have been turned until the "6" on the word space scale came in line with the "8" on the expand index. Cam 232 would then be in a position to close contacts 269 and cams 230, 231 would be in such positions that contacts 253 and 266 were open. Contacts 254 would be held closed by the cam 230. An actuation of the space bar would complete a circuit through contacts 269 for energizing the solenoid 96C to provide a five unit spacing between words, and the solenoid 282 would be energized through contacts 254 to shift the cams one step. After two operations of the space bar, the cam 232 would be in a position to open contacts 269 and the cam 231 would close contacts 266. Continued operation of the space bar for the remaining four word spaces would result in four unit spacing for

each operation. It will be seen that the retyped line would be expanded eight units, two units for each of the first two word spaces and one for each of the other four.

Condensing operation

As has been previously described, in an expanding action one of the contacts **253**, **266** or **269** is closed at all times to give either three, four or five unit spacing between words. The triangular indicator **242** is in such a position on the dial **237** that any setting of the indicator opposite the condense index **246** results in a positioning of low dwells **330***a*, **330***b* and **330***c* (Figs. 11 and 12) on cams **230**, **231** and **232**, respectively, opposite the contacts **253**, **266** and **269** so that the latter are in open positions. With contacts **253**, **266** and **269** open, none of the solenoids **96A**, **96B** or **96C** can be energized and an actuation of space bar **110** gives two unit spacing in a manner previously described. Actuation of the space bar **110**, however, rotates the cam assembly counterclockwise (to the left in Fig. 12) since the contacts **254** are closed to complete the circuit including the solenoid **282**. A rotation of the cams in steps continues until the high dwell **249** on cam **230** closes contacts **253** when three unit spacing between words is again obtained.

For example, if a trial line is to be condensed four unit spaces, the triangular indicator **242** on the dial **237** is set opposite the "4" on the condense index **246**. This moves the high dwell **249** of the cam **230** four unit widths from the contact **253**. Contacts **253** as well as contacts **266** and **269** are open at this time and a spacing of two units between words is obtained when the space bar is actuated. The contacts **254** are closed, however, to effect a turning of the cams counterclockwise one step for each actuation of the space bar **110**. After four actuations of the space bar, the cams have rotated to the home position where the high dwell **249** closes contact **253** and opens contacts **254** and **256**. This results in normal three unit spacing until the end of the line as there is no further rotation of the cams with the contacts **254** open. It will be seen that a total subtraction of four unit spaces from the trial line is effected.

Limit switch

The word space scale **239** contains only ten units. A limit switch **312** (Figs. 7 and 11) is provided to take care of a condition in an expansion operation in which there are more than ten word spaces in a trial line. An arm **340**, Fig. 7, is fastened to the ratchet **160** and is positioned so that it strikes a transfer arm **341** of the limit switch **312** after ten actuations of the space bar. This moves the transfer arm **341** against the action of a spring **342** and effects an opening of the normally closed contacts and a closing of the normally open contacts of limit switch **312**. An actuation of the space bar **110** in this condition completes a circuit (Fig. 11) from one side of the 110 volt line **216** through wire **217**, wire **218**, word space contact **126**, wire **219**, wire **311**, the normally open contacts of the limit switch **312**, wire **343** and the solenoid **96A** to the other side of the line. This energization of solenoid **96A** results in three unit spacing and occurs each time the space bar **110** is actuated after ten consecutive word spacings.

As has been previously pointed out, the word space counter can only count up to ten word spaces. If there are more than ten word spaces, the counter remains on ten. It is not necessary to have a counter of greater capacity because the justifier is designed to do its expanding in a maximum of ten word spaces.

For example, if a trial line is to be expanded twelve unit spaces and there are eleven word spaces in the line, the "10" on the word space scale **239** would be moved opposite the "12" on the expand index **244**. In Fig. 12, this movement shows up as a shifting to the right of the cams **230**, **231** and **232** to the position where the tenth high dwell on cam **230** has moved twelve units past the contacts **253**. In this position, contacts **269** are closed by the tenth high dwell of the selector cam **232** to give five unit spacing. After two actuations of the space bar **110**, the cam assembly has moved to the point where the tenth high dwell of the selector cam **231** closes contact **266** to give four unit spacings. Contacts **269** are open at this time. After eight more actuations of the space bar, there has been an expansion of the desired 12 unit spaces. Since there is one more word space, another actuation of the space bar **110** would give four unit spacing and the line would be one unit space too long. However, the limit switch is transferred at this point to provide the necessary three unit spacing. It will be appreciated that the operations of the space bar during the typing of a justified line may result in stepped rotations of both the word space counter dial **162** and the control cams. This is due to the fact that the solenoid **177** is energized on each operation until ten word spaces have been counted, and the solenoid **282** is energized on each operation until a high dwell on cam **230** opens contacts **254**.

It can now be understood why the word space counter has to be resettable by operations of the tabular key **132** and the carriage return key **127**. As has been previously described, if a long carriage is used, the operator can type the trial line on the rough draft and perform a tabulation operation to the new sheet preparatory to retyping the line. If the counter ratchet **160** were not reset and the trial line had more than ten words, the limit switch **312** would have been transferred by the arm **340** and no matter what setting the operator made, three unit spacing would always result, preventing proper justification. If the trial line had less than ten words and the counter ratchet was not reset, then an expanding or condensing of the spaces between some of the words in the retyped line may be obtained but this would be stopped as soon as the word space counter reached a position indicating a counting of ten words. The same situation would exist if the word space counter was not returned to its zero position each time that the carriage was returned for typing a new line on the same sheet.

The resetting of the word space counter is accomplished, as mentioned above, by energizing the solenoid **198**. This is done by either closing the contacts **138** on operation of the tabulation key or transferring the contacts **130** by operation of the carriage return key. Closing the contacts **130** completes a circuit from the power source **216** through conductor **217**, contacts **130**, conductor **221**, normally closed side of contacts **138**, conductor **222** and solenoid **198** to conductor **220** at the other side of the power source. A transfer of the contacts **138** results in the completion of a circuit like the above except that the conductor **217** is connected through the normally open side of contacts **138** to the conductor **222**.

Restoring

Since the cam assembly is rotated only one step for each word space, the cam assembly might not be completely restored to a zero position after typing a justified line. If the cam assembly was not restored to zero position before the next trial line was typed, then word spaces of more than three units would be obtained in the trial line until the cams were restored and the reading on the indicator **150** would be incorrect.

For instance, if a line is to be expanded 12 unit spaces and there are 7 word spaces in the line, the dial **237** is set so that a "7" on the word space scale **239** is opposite a "12" on the expand index **244**. In Fig. 12, this movement shows up as a shifting to the right of the cams **230**, **231** and **232** to the position where the seventh high dwell on cam **230** has moved twelve units past the contacts **253**. In this position, contacts **269** are closed by the seventh high dwell of the selector cam **232** giving five unit spacing. This high dwell is effective for five word spaces and then the selector cam **231** high dwell is effective for the

next two steps. The line is now complete but the cam assembly is not yet back to its zero position.

The resetting of the cam assembly to a zero position is automatically effected upon a carriage return operation by mechanism which is most clearly shown in Fig. 9.

A pin **350** (Figs 9 and 10) connects a motion multiplier arm **351** to the lever **276**. The motion multiplier arm **351** is pivoted at one end on a stationary pin **352** and is connected at its other end through a toggle spring **353** to a bell crank **354** which is pivoted at **356**.

It will be remembered that an energizing of solenoid **282** by an actuation of the space bar **110** effects a lowering of the lever arm **276**. The pin **350** transmits the motion of the lever arm **276** to the motion multiplier arm **351**. The motion multiplier arm **351** pivots about pin **352** and rocks the toggle spring **353** to effect a clockwise motion (counterclockwise in Fig. 9) of the bell crank **354** about point **356**. The bell crank **354** strikes an extension **357** on one of a pair of contacts **308** and opens the latter. A deenergizing of solenoid **282** effects a raising of the lever arm **276** which pivots the motion multiplier arm **351** so as to rock the toggle spring **353** in such a manner as to cause the bell crank **354** to release the transfer arm **357** and effect a closing of contact **308**.

It will be remembered that actuating the carriage return key caused the contacts **130** to close. From Fig. 11, it can be seen that a closing of contacts **130** completes a circuit from one side of the 110 volt line **216** through the wire **217**, carriage return contacts **130**, wire **358**, contacts **256**, wire **359**, to a point **361**, through wire **362**, a restore relay R–1 and wire **220** to the other side of the 110 volt line. Since the contacts **256** are closed unless the selector cam **230** is in a home position, the restore relay R–1 will be energized by the carriage return contact **130** only when the cam assembly is not in a home position. Energizing restore relay R–1 opens contacts R–1*b*, closes contacts R–1*c* and transfers contacts R–1*a*. Closing contact R–1*c* and the normally open contacts of R–1*a* completes a circuit from one side of the 110 volt line **216** through wire **217**, wire **363**, contacts R–1*a*, wire **306**, contacts **254**, wire **307** to point **364**. From point **364** the circuit continues through wire **366**, contacts R–1*c*, point **361**, wire **362** and the restore relay R–1 to wire **220** at the other side of the line. This circuit acts as a holding circuit to keep relay R–1 energized even after the carriage return contacts **130** have been opened. Another circuit is completed from point **364** through wire **307**, restore contacts **308**, wire **310**, advancing solenoid **282** and wire **220** to the other side of the line, energizing solenoid **282**. The energized solenoid **282** acts as previously described to advance the cam assembly one step and also to mechanically open contacts **308** for deenergizing solenoid **282**. Contacts **308** control the energizing and deenergizing of solenoid **282** because contacts R1*b* are held open by relay R–1. The deenergized solenoid **282** permits plunger arm **197** to rise and effect a closing of contact **308**. This reenergizes solenoid **282** to effect another advancement of the cam assembly. This reciprocating motion to restore contacts **308** continues until the cam assembly has been restored to a home position at which time contacts **254** open deenergizing the advancing solenoid **282** and preventing further advancement.

While there have been shown and described and pointed out the fundamental novel features of the invention as applied to a preferred embodiment, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art without departing from the spirit of the invention. It is the intention, therefore to be limited only as indicated by the scope of the following claims.

What is claimed is:

1. A machine for preparing justified copy comprising, in combination, a carriage, an escapement mechanism operable to enable said carriage to be fed a plurality of different extents; means including a plurality of electromagnets separately energizable for selecting the different extents of feed of said carriage; a plurality of contacts associated with said plurality of electromagnets and individually series connected with corresponding ones of said electromagnets; a selector device having a plurality of cams, one cam associated with each of said plurality of contacts, each cam having a plurality of high dwells, said high dwells being operable to close only one of said plurality of contacts at any settable position of said selector device; a spacing contact, word spacing means for closing said spacing contact and operating the escapement mechanism for a selected extent of feed of said carriage, circuit means for energizing said plurality of electromagnets through said plurality of contacts and said spacing contact, and means operable upon actuation of said spacing means for changing the position of said selector device.

2. In a machine of the class described, a carriage, an escapement mechanism including selectively operable devices to enable said carriage to be fed a plurality of different extents, means including a first electromagnet energizable for selecting one of said selectively operable devices to feed the carriage a normal extent, means including a plurality of electromagnets separately energizable for selecting different ones of said selectively operable devices to feed said carriage extents progressively greater than said normal extent, word spacing means for operating the selectively operable devices and operable on one of said selectively operable devices to feed said carriage less than said normal extent when neither said first electromagnet or said plurality of electromagnets are energized, and means including a spacing contact controlled by said spacing means for selectively energizing said electromagnets.

3. In a machine of the class described, a carriage, an escapement mechanism including selectively operable devices to enable said carriage to be fed a plurality of different extents, a manually actuatable word spacing means for operating one of said selectively operable devices to feed the carriage a first extent, a first electromagnet energizable for operating another of said selectively operable devices to feed the carriage a second extent greater than said first extent, a plurality of electromagnets selectably energizable for operating said selectively operable devices to feed the carriage a plurality of extents progressively greater than the second extent, cam contacts associated with said first and plurality of electromagnets and individually series connected with corresponding ones of said first and plurality of electromagnets, a selector device having a plurality of cams, one cam associated with each of said cam contacts, said cams being operable to close only one of said cam contacts at any settable position of said selector device, means including a spacing contact controlled by said spacing means for energizing said first and plurality of electromagnets through said cam contacts, and means operable upon actuation of said spacing means for changing the position of said selector device.

4. A justifying mechanism for a typewriter comprising, in combination, a carriage, an escapement mechanism including devices independently operable for permitting different movements of said carriage, means including solenoids which are operable when energized for selecting different ones of said devices for operation, parallel circuits for said solenoids, a pair of normally open contacts connected in each of said circuits, a plurality of cams, one for each pair of contacts, said cams being shaped so as to effect a closing of said pairs of contacts in succession and with only one pair closed at a time, means including an electromagnet for moving said cams step by step, a source of electric power, means including a normally open switch for connecting said electromagnet and said parallel circuits to said power source, a manually operable spacing element for said typewriter, and means operable upon an actuation of said spacing element for closing said switch and actuating the selected ones of said devices.

5. The mechanism of claim 4 in which said cams are provided with high dwells for closing the pairs of contacts associated therewith, said high dwells on each cam being spaced apart progressively increasing distances, and the high dwells on all but one of said cams having progressively increasing widths.

6. The mechanism of claim 4 including a pair of normally closed contacts connected in series with said electromagnet for controlling the energizing of the latter, and means actuated by one of said cams for opening said pair of normally closed contacts when the pair of normally open contacts associated with said cam are closed.

7. The mechanism of claim 4 including a transfer switch connected between said normally open switch and said parallel circuits, said transfer switch being normally in a position to connect said normally open switch to said parallel circuits, a conductor connecting the normally open side of said transfer switch to one of said solenoids, and means operable upon actuating said spacing element a predetermined number of times for transferring said transfer switch.

8. A justifying mechanism for a typewriter comprising, in combination, a carriage, an escapement mechanism including devices independently operable for permitting different movements of said carriage, means including solenoids which are operable when energized for selecting different ones of said devices for operation, parallel circuits for said solenoids, a pair of normally open contacts connected in each of said circuits, a plurality of cams, one for each pair of contacts, said cams being shaped so as to effect a closing of said pairs of contacts in succession and with only one pair closed at a time, means including an electromagnet for moving said cams in steps, a source of electric power, means including a normally open switch for connecting said parallel circuits to said source of power, a circuit connected between said switch and said power source and including said electromagnet, a pair of normally closed contacts connected in said circuit, means actuated by one of said cams for opening said normally closed contacts when the normally open contacts associated with said cam are closed, two pairs of normally closed parallel connected contacts arranged in said circuit, means operable upon the stepping of said cams by an energizing of said electromagnet for opening one pair of said parallel connected contacts, means including a relay which is operable when energized for opening the other pair of said parallel connected contacts, a circuit for energizing said relay, said relay circuit including a pair of normally closed contacts, means actuated by the one of said cams controlling said first mentioned pair of normally closed contacts for opening said last mentioned pair of contacts when the normally open contacts associated with said cam are closed, a normally open switch connected in said relay circuit, a carriage return key for said typewriter, and means actuated by said carriage return key for closing said last mentioned switch.

9. The mechanism of claim 8 including a holding circuit connecting one side of said pairs of parallel connected contacts to one side of said relay, and a pair of normally open relay contacts connected in said holding circuit, said relay operating when energized for closing said normally open relay contacts.

10. A justifying mechanism for a typewriter comprising, in combination, a carriage, an escapement mechanism including devices independently operable for permitting different movements of said carriage, means including solenoids which are operable when energized for selecting different ones of said devices for operation, parallel circuits for said solenoids, a pair of normally open contacts connected in each of said circuits, a plurality of cams, one for each pair of contacts, said cams being shaped so as to effect a closing of said pairs of contacts in succession and with only one pair closed at a time, means including an electromagnet for moving said cams step by step, means including a normally open switch for connecting said electromagnet and said parallel circuits to said source of power, said last mentioned means also including a pair of normally closed contacts connected in series with said electromagnet, means actuated by one of said cams for opening said normally closed contacts when the pair of normally open contacts associated with said cam are closed, a manually operable spacing element for said typewriter, means operable upon an actuation of said spacing element for closing said switch and actuating the selected ones of said escapement mechanisms, a word space counter associated with said justifying mechanism, means including an advance solenoid for moving said counter step by step to counting positions, a circuit including said advance solenoid and connected in parallel with said parallel circuits, means including a solenoid for returning said counter to its zero position, a circuit including a normally open switch for controlling the energizing of said last mentioned solenoid, a carriage return key for said typewriter, and means actuated by said carriage return key for closing said last mentioned switch.

11. A justifying mechanism for a typewriter comprising, in combination, a carriage, selectively operable devices for permitting variable escapement of said carriage, interposers movable into operating positions relative to said devices and adapted to be actuated for operating different ones of said devices, a member operable to actuate said interposers when moved to said operating positions, means including solenoids which are operable when energized for moving said interposers into said operating positions, parallel circuits for said solenoids, a pair of normally open contacts connected in each of said circuits, a plurality of cams, one for each pair of contacts, each of said cams having high dwells for closing the pair of contacts associated therewith, said high dwells being so located that only one pair of contacts is closed at a time, means including an electromagnet for moving said cams step by step so as to shift the positions of said high dwells relative to said pairs of contacts, a source of electric power, means including a normally open switch for connecting said electromagnet and said parallel circuits to said power source, a space bar for said typewriter; and means operable upon an actuation of said space bar for closing said switch and operating said member.

12. The mechanism of claim 11 including a pair of normally closed contacts connected in series with said electromagnet, and means operable by the high dwells of one of said cams for opening said normally closed contacts when the normally open contacts associated with said cam are closed.

13. The mechanism of claim 11 including an interposer continually located in an operating position relative to said devices and operable, when actuated alone by said member, for effecting a minimum escapement of said carriage, and low dwells on said cams at points which may be presented simultaneously to said pairs of contacts.

14. In a machine of the class described, a carriage, an escapement mechanism to enable said carriage to be fed to different extents, means including an electromagnet for selectively conditioning said escapement mechanism for the different extents of feed, a manually actuatable word spacing means operable on said escapement mechanism to feed the carriage one extent when said electromagnet is energized and a lesser extent when said electromagnet is not energized, a cam contact associated with said electromagnet, means for closing said contact including a cam having a high dwell which is settably positioned from said cam contact a distance representative of the variation of a line with respect to a fixed line, means for advancing said high dwell of said cam towards said cam contact upon actuation of said word spacing means, contact means under control of said cam for disabling said advancing means, and circuit means for energizing said electromagnet including said cam contact.

15. In a machine for preparing justified copy comprising, in combination, a carriage, an escapement mecha-

nism operable to enable said carriage to be fed a plurality of different extents; means including a plurality of electromagnets separately energizable for selecting the different extents of feed of said carriage; a plurality of contacts associated with said plurality of electromagnets and individually series connected with corresponding ones of said electromagnets; a selector device having a plurality of cams, one cam associated with each of said plurality of contacts, said cams being operable to close only one of said plurality of contacts at any settable position of said selector device; a spacing contact, word spacing means for closing said spacing contact and operating the escapement mechanism for a selected extent of feed of said carriage, circuit means for energizing said plurality of electromagnets through said plurality of contacts and said spacing contact, and means operable upon actuation of said spacing means for changing the position of said selector device, said last mentioned means including an electrically operated device, and means including contacts controlled by one of said cams for energizing said electrically operated device.

References Cited in the file of this patent

UNITED STATES PATENTS

480,350	Street et al.	Aug. 9, 1892
2,379,862	Bush	July 10, 1945