Dec. 4, 1956 W. WILLIAMS 2,772,613

PHOTOCOMPOSING APPARATUS AND JUSTIFYING APPARATUS

Filed March 18, 1955 6 Sheets-Sheet 1

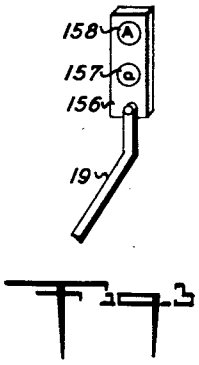


Fig. 3

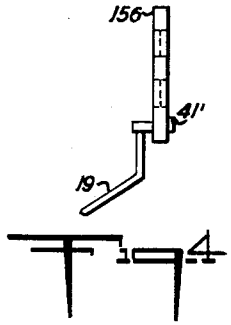


Fig. 4

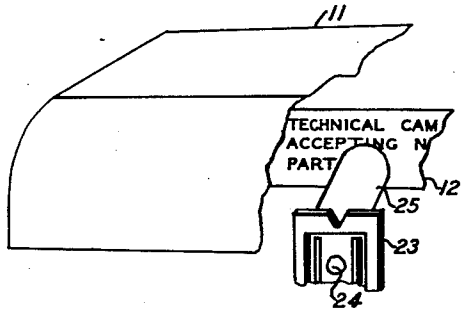


Fig. 2

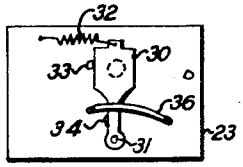


Fig. 5

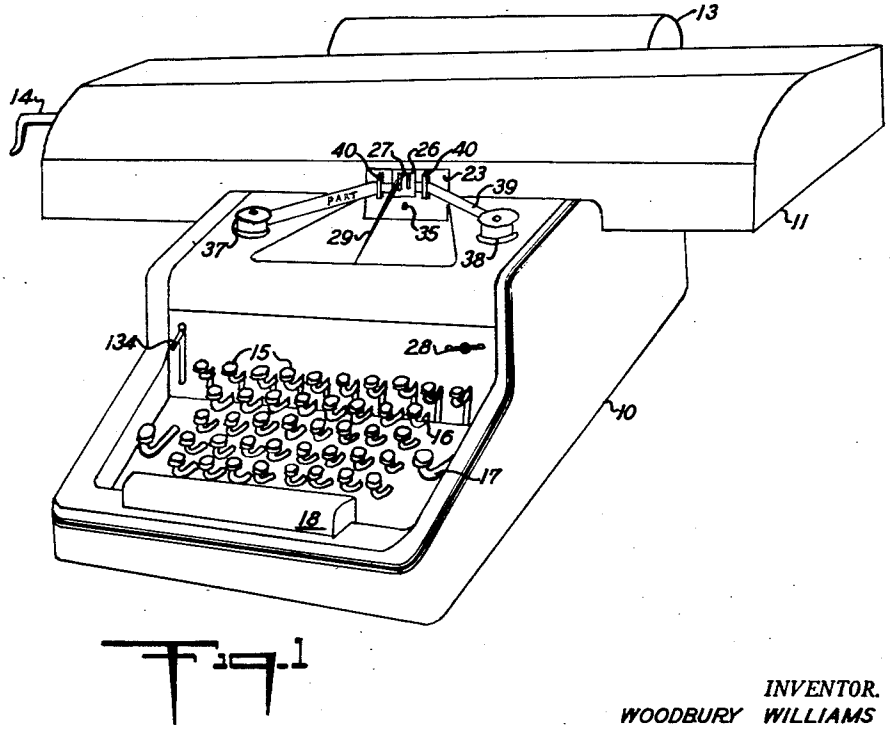


Fig. 1

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PHOTOCOMPOSING APPARATUS AND JUSTIFYING APPARATUS

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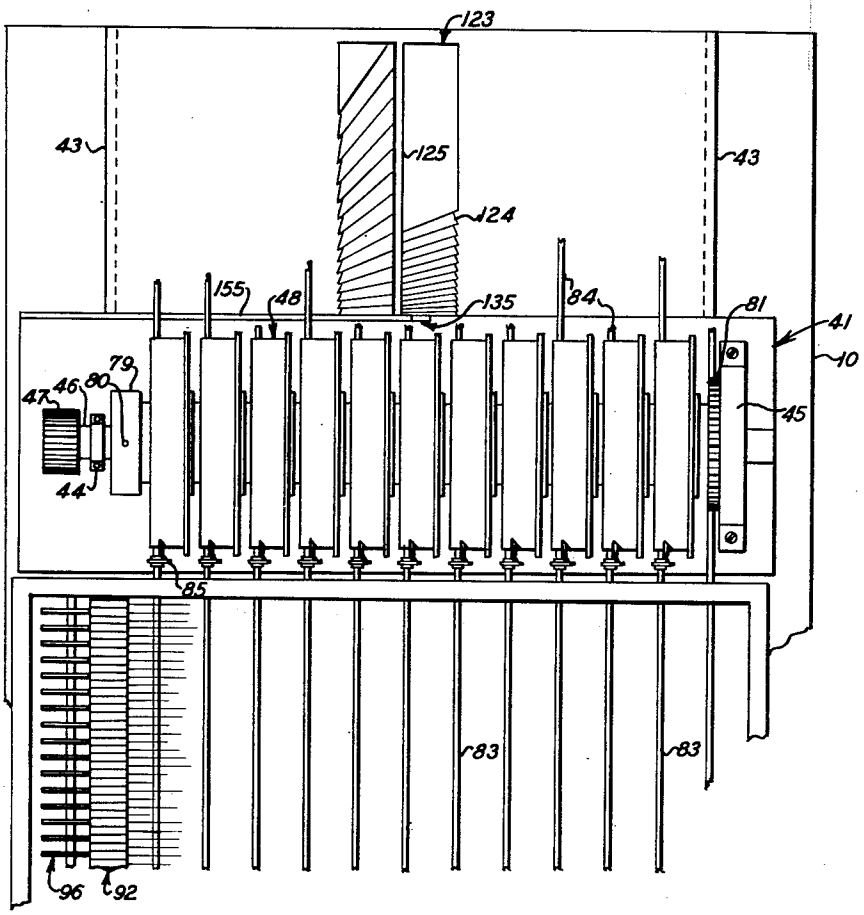


FIG. 16

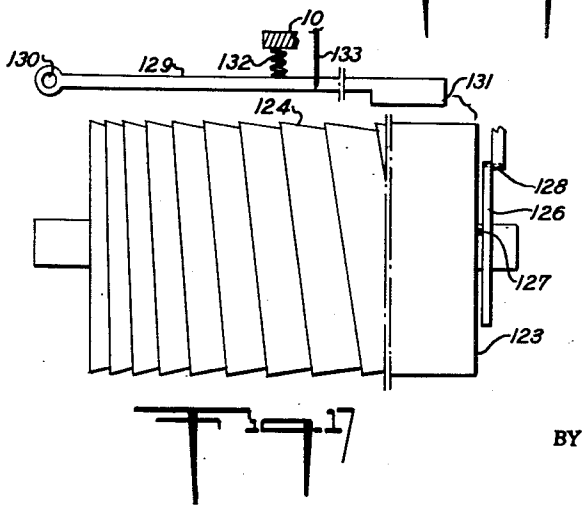


FIG. 17

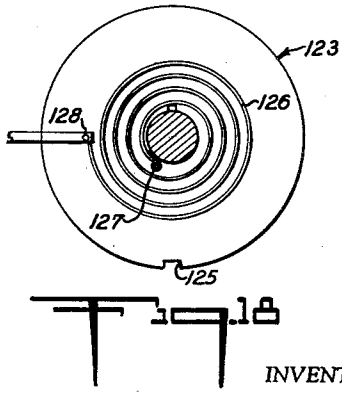


FIG. 18

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PHOTOCOMPOSING APPARATUS AND JUSTIFYING APPARATUS

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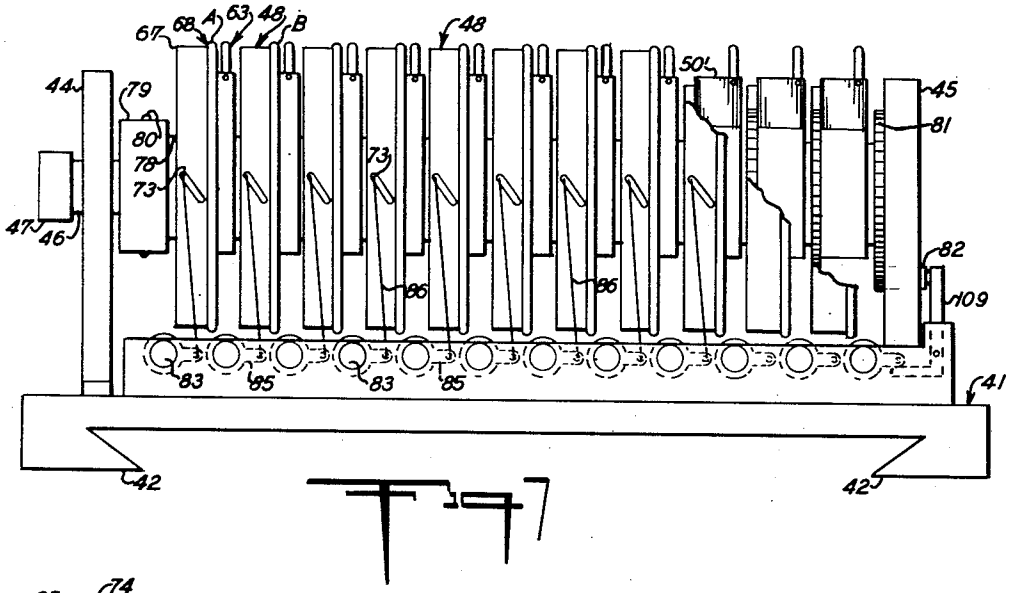


Fig. 7

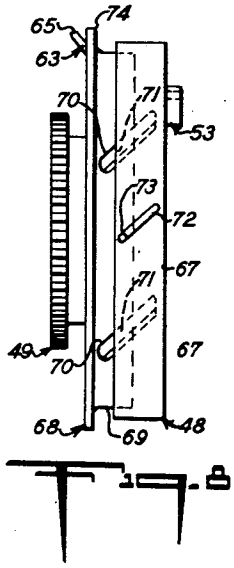


Fig. 8

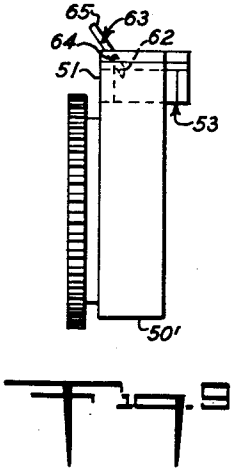


Fig. 9

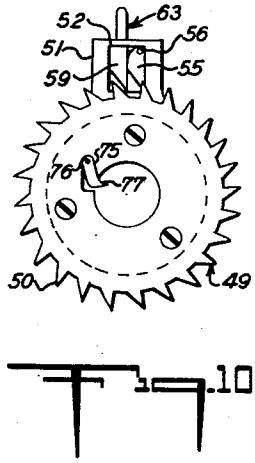


Fig. 10

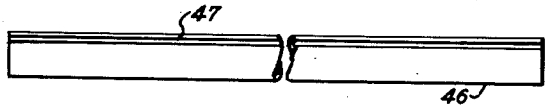


Fig. 15

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PHOTOCOMPOSING APPARATUS AND JUSTIFYING APPARATUS

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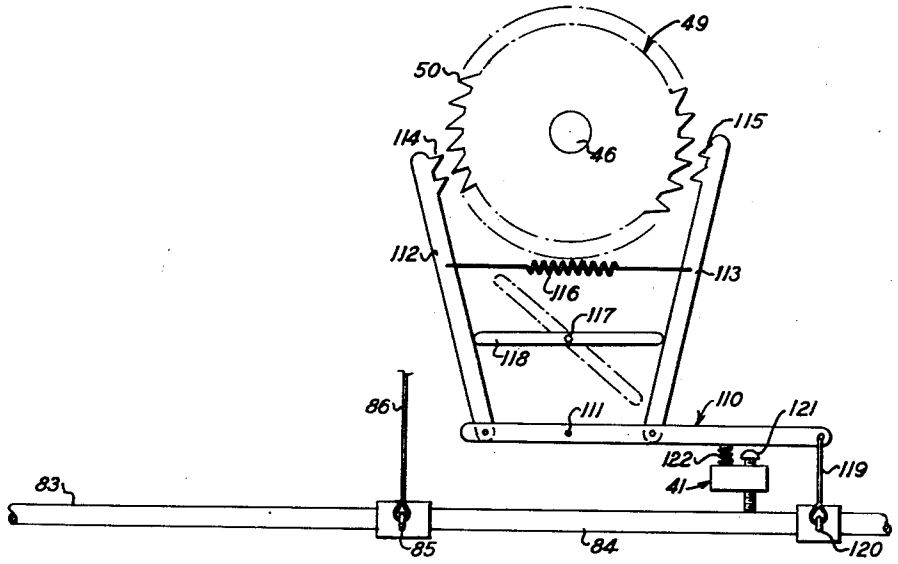


Fig. 16

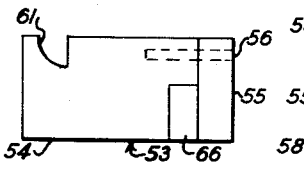


Fig. 11

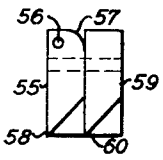


Fig. 12

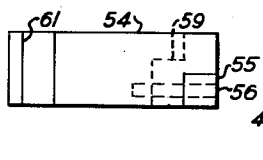


Fig. 13



Fig. 14

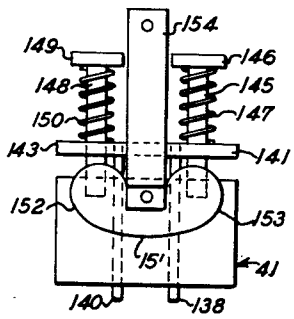


Fig. 22

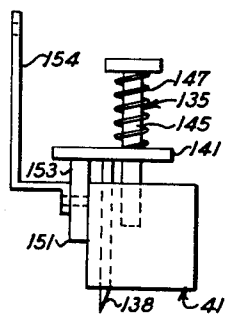


Fig. 23

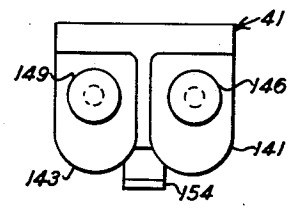


Fig. 24

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PHOTOCOMPOSING APPARATUS AND JUSTIFYING APPARATUS

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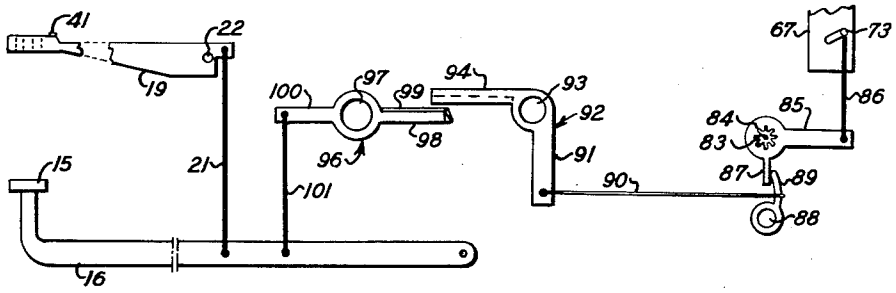


Fig. 19

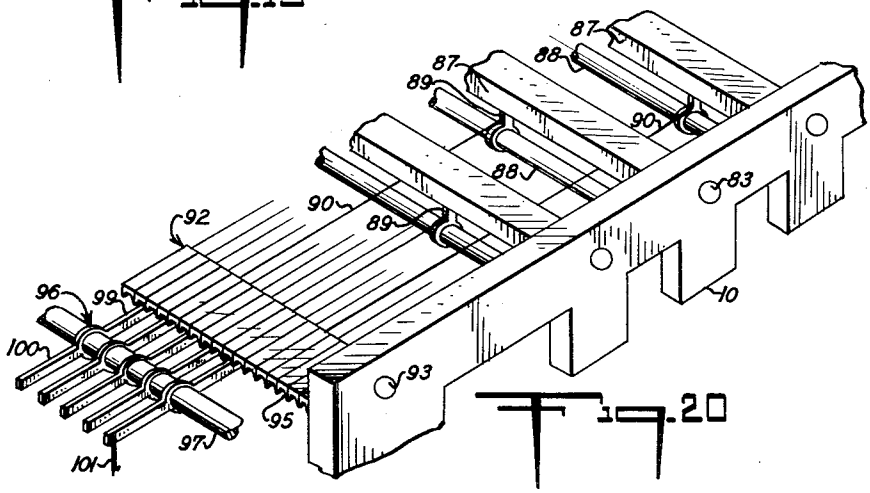


Fig. 20

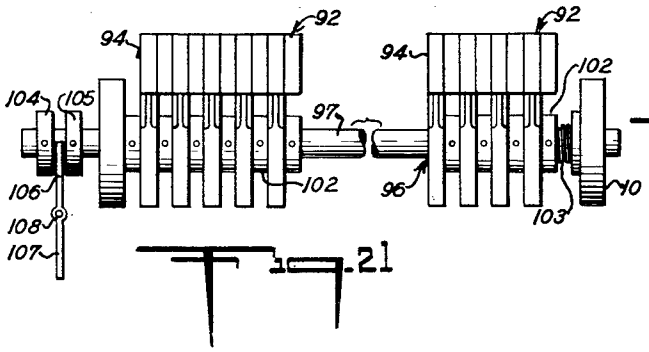


Fig. 21

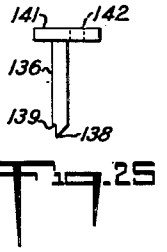


Fig. 25

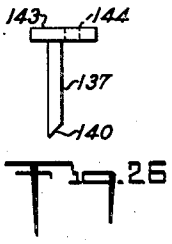


Fig. 26

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PHOTOCOMPOSING APPARATUS AND JUSTIFYING APPARATUS

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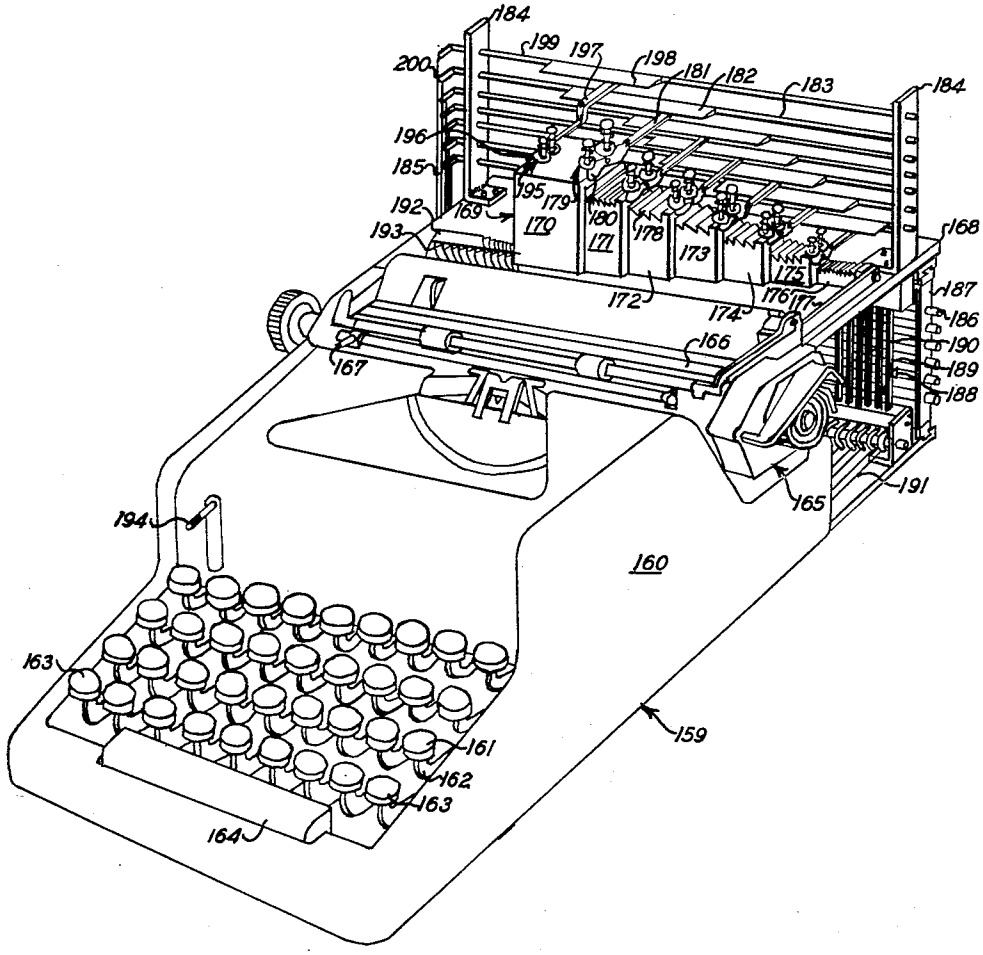


Fig. 27

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United States Patent Office 2,772,613 Patented Dec. 4, 1956

2,772,613

PHOTOCOMPOSING APPARATUS AND JUSTIFYING APPARATUS

Woodbury Williams, Rockville Centre, N. Y.

Application March 18, 1955, Serial No. 495,115

18 Claims. (Cl. 95—4.5)

This invention relates to the graphic arts and more particularly to a photocomposing apparatus for providing an exposed film containing properly composed and justified material and also to a justifying apparatus which may be applied to a conventional typewriter.

It is considered that a commercially practical photocomposing machine must operate on a letter by letter principle and at a high speed, as well as being substantially fully automatic. The machine must also provide perfect spacing for each letter and also must be capable of automatically justifying each line of composition. Furthermore, the machine should provide a visual indication of the letters being composed and should provide means whereby errors may be corrected prior to exposing of the film.

It is also desirable that a photocomposing apparatus be relatively small and convenient to use and of a character which permits convenient installation and removal of film in daylight and also the cost of construction of such photocomposing apparatus should not be prohibitive. It is furthermore desirable, that a photocomposing appaartus be provided with mechanism, or be so constructed that such mechanism may be conveniently applied thereto, to permit, what is known in the art, as "kerning" or in other words, to vary the spacing between certain of the characters whereby such characters overlap, thereby eliminating the illusion that certain characters are spaced more widely than other characters.

Heretofore, many attempts have been made to provide photocomposing machines which meet the above requirements and in which the cost is not prohibitive, but in the main, these prior efforts resulted in extremely large, complicated and costly machines which has prohibited the use of such machines in the smaller print shops and, in fact, the complexity of these prior art machines has rendered the maintenance thereof, quite difficult and costly.

As is well known, conventional typewriters do not provide justified lines of printing, or in other words, lines which all end at substantially the same place, and since the appearance of justified copy is far superior to the printing normally provided by a typewriter, it is considered highly desirable to provide a relatively simple, yet highly effective apparatus which may be applied to a conventional typewriter and which will provide substantially automatic justification thereby producing typewritten copy closely resembling printed copy.

Prior efforts to provide justifying typewriters have resulted in extremely complex mechanism and these prior art machines have also been extremely costly and subject to frequent breakdown, which has precluded widespread use of the same.

It is accordingly an object of this invention to provide a photocomposing apparatus of relatively simple and economical construction which will, in general, meet all of the requirements for a commercially practical photocomposing machine.

A further object of the invention is the provision of a photocomposing apparatus which essentially consists in modifying a conventional typewriter to permit correct composition and justification and to provide an exposed film carrying the completed copy.

A still further object of the invention is the provision of a photocomposing apparatus incorporating back spacing means which permits the correction of errors in characters prior to exposing the film to such characters.

Another object of the invention is the provision of a photocomposing apparatus in which a written record visible to the operator is provided, in order that the composition may be checked prior to exposing the film.

A further object of the invention is the provision of a photocomposing apparatus which may be conveniently modified to permit "kerning."

A still further object of the invention is the provision of a photocomposing apparatus in which each line of composition may be automatically justified, regardless of the number of words appearing in the line.

Another object of the invention is the provision of a photocomposing machine in which predetermined spacing for any character or group of characters may be provided.

A further object of the invention is the provision of a photocomposing machine in which each line of composition is automatically justified and in which the justifying mechanism automatically returns to zero preparatory to justifying the next line of composition.

A still further object of the invention is the provision of a photocomposing apparatus which may be constructed upon a frame little larger than the conventional typewriter and which is of relatively simple construction thereby materially reducing maintenance costs.

Another object of the invention is the provision of justifying apparatus which may be incorporated in a conventional typewriter, either by modifying the present typewriters to incorporate the same, or by redesigning the typewriter to be built in the first instance, including such justifying apparatus.

A further object of the invention is the provision of a justifying apparatus for a typewriter which will automatically operate to justify each line of printing and which will not materially add to the physical size of such typewriter.

Another object of the invention is the provision of photocomposing apparatus and justifying apparatus for a typewriter of such design and construction that character spacing and word spacing may be maintained to very close tolerances and in which normal wear of the parts will not result in any material change in such spacing.

Further objects and advantages of the invention will be apparent from the following description taken in conjunction with the accompanying drawings wherein:

Fig. 1 is a view in perspective showing a photocomposing apparatus constructed in accordance with this invention;

Fig. 2, a fragmentary view in perspective with parts broken away for greater clarity and showing a portion of the exposed film as well as a portion of the optical system utilized for exposing such film;

Fig. 3, a fragmentary view in perspective showing a type bar and the manner of supporting character outlines thereon;

Fig. 4, a fragmentary side elevational view of the type bar and character support shown in Fig. 3;

Fig. 5, a front elevational view of a shutter mechanism actuated by operation of each type bar to expose the film to a single character;

Fig. 6, a fragmentary top plan view of the character spacing mechanism as well as the justifying mechanism

utilized in the photocomposing apparatus of this invention;

Fig. 7, a fragmentary front elevational view of the character spacing mechanism shown in Fig. 6;

Fig. 8, a side elevational view of one of the character spacing ratchet wheels together with the associated escapement mechanism and operating means therefor;

Fig. 9, a side elevational view of a character spacing ratchet wheel as well as the associated escapement mechanism;

Fig. 10, an end elevational view of one of the character spacing ratchet wheels and the escapement mechanism;

Fig. 11, a front elevational view of the escapement mechanism utilized for controlling the step by step movement of the character spacing ratchet wheels;

Fig. 12, an end elevational view of the escapement mechanism shown in Fig. 11;

Fig. 13, a top plan view of the escapement mechanism shown in Fig. 11;

Fig. 14, an end elevational view of the shaft utilized to support the character spacing ratchet wheels;

Fig. 15, a side elevational view of the character wheel supporting shaft;

Fig. 16, a side elevational view of the back spacing mechanism utilized in conjunction with the character spacing ratchet wheels;

Fig. 17, a side elevational view of the justifying drum and the brake mechanism associated therewith;

Fig. 18, an end elevational view of the justifying drum shown in Fig. 17 and showing the spring return means for such drum;

Fig. 19, a diagrammatic view showing the control lever and linkage system for operating the character spacing ratchet wheels in response to the operation of the key bar of the typewriter;

Fig. 20, a fragmentary perspective view showing a portion of the control lever and linkage system for operating the character spacing ratchet wheels;

Fig. 21, a fragmentary top plan view of the mechanism for obtaining the difference in character spacing required by upper and lower case characters;

Fig. 22, a front elevational view of an escapement mechanism utilized in conjunction with the justifying drum;

Fig. 23, a side elevational view of the escapement mechanism shown in Fig. 22;

Fig. 24, a top plan view of the escapement shown in Fig. 22;

Fig. 25, a side elevational view of one of the escapement pawls utilized in the escapement mechanism of Fig. 22;

Fig. 26, a side elevational view of the other escapement pawl utilized in the escapement mechanism of Fig. 22; and

Fig. 27, a perspective view showing a typewriter incorporating the justifying mechanism of this invention.

With continued reference to the drawing, there is shown in Fig. 1 a typewriter, having the usual base or frame 10 and provided with a slidably mounted carriage covered by suitable hood or housing 11, there being a roller within the housing 11 and mounted on the carriage, such roller serving to receive and feed a photographic film 12 which may be contained in a film magazine 13 mounted on the carriage. The carriage is also provided with the usual carriage return bar 14 which serves to rotate the roller and advance the film 12 the distance between lines of characters to be printed. The typewriter is further provided with finger engaging keys 15, key bars 16, shift keys 17 and a space bar 18. The keys 15 and key bars 16 serve to operate type bars 19 in a conventional manner and for purposes of illustration, there is shown in Fig. 19, a key bar 16 pivotally mounted at 20 on a suitable part of the frame 10, the key bar 16 being connected through a link or flexible member 21 with the type bar 19 which in turn is pivotally mounted at 22 on the frame 10 of the typewriter.

Mounted on the frame 10 of the typewriter is a plate 23 having an aperture 24 therein and to the rear of the plate 23 and in alignment with the aperture 24 is an optical system, not shown, which may be contained in a suitable housing, such as a tube 25. Slidably mounted on the plate 23 is a slide 26 having an aperture 27 and the slide 26 may be operated by a key 28 on the frame 10 to move the slide 26 into position with the aperture 27 in alignment with the aperture 24 in the plate 23, or upon a suitable operation of the key 28, the slide 26 may be moved to close the aperture 24 in the plate 23. A light source, not shown, is mounted on the frame 10 and serves to project beam of light 29 through the aperture 27 in the slide 26 and through the aperture 24 in the plate 23 to the optical system 25 which serves to focus such beam of light on the photographic film 12.

Mounted on the rear of the plate 23 is a shutter 30 which may be pivotally mounted at 31 and which may be urged into position closing the aperture 24 in the plate 23 by a tension spring or other suitable means 32, there being a stop 33 provided to prevent movement of the shutter 30 beyond a predetermined position. The shutter 30 may be operated by a cam 34 having a portion 35 projecting through the plate 23 and engageable by the type bar 19 upon operation of the same and movement of the shutter 30 may be retained in the desired path by a guide 36 attached to the plate 23 and overlying a portion of the shutter 30.

Also provided on the frame 10 of the typewriter are spools 37 and 38 which serve to receive and feed a paper tape 39, which tape moves through guides 40 provided on the front face of the plate 23 and the paper tape 39 serves to receive a printed impression of a type face 41' carried on each type bar 19. In this manner, all characters which may be printed by operating the keys 15 are impressed on the paper tape 39 which provides a visual record for the operator of the apparatus.

The carriage 11 of the typewriter is provided with the usual rack bar, not shown, and the forward movement of the carriage 11 is controlled through this rack bar by the mechanism shown in Figs. 6 and 7. With particular reference to these figures, there is shown a base 41 with slides 42 slidably mounted on guideways 43 on the frame 10 and the base 41 is provided adjacent each end thereof, with upstanding bearing blocks 44 and 45. These bearing blocks serve to rotatably mount a shaft 46 provided on one end with a pinion 47 which meshes with the rack bar, not shown, on the carriage 11. Consequently, upon forward or rearward movement of the carriage 11, the shaft 46 will be rotated by engagement of the rack bar with the pinion 47. As shown in Figs. 14 and 15, the shaft 46 is provided with a keyway 47 extending throughout substantially the length thereof. The purpose and operation of this keyway 47 will be later described.

As is well known, certain characters require greater spacing than other characters and for instance, the character W requires a much greater spacing than the character I. Since, however, several characters require substantially the same spacing, it is unnecessary to provide separate character spacing means for each character, but certain characters may be grouped together in conjunction with a single character spacing means. For the purpose of providing proper character spacing in the photocomposing apparatus of this invention, there may be provided a plurality of character spacing units 48 mounted on the shaft 46 and it is considered that a detailed description of one of these units will suffice for all of such units, since the structure thereof is substantially the same, the only difference between the unit being in the spacing resulting from operation of each unit.

With particular reference to Figs. 8 to 13, each char-

acter spacing unit 48 may comprise a ratchet wheel 49 having ratchet teeth 50 on the circumference thereof and the pitch of such teeth or, in other words, the distance from a point on one tooth to a corresponding point on the next tooth will be sufficient to advance the carriage 11 the required amount upon rotation of the ratchet wheel 49 from one tooth to the next. The ratchet wheel 49 is provided with an enlarged hub 50' and such hub is provided at one side thereof with a radially extending boss 51 having an axially extending, substantially rectangular recess 52 therein. Recess 52 serves to slidably receive an escapement mechanism 53 which, as best shown in Figs. 11 to 13, may comprise a generally rectangular block 54 on the forward end of which is pivotally mounted a pawl 55 on a pivot pin 56 extending into the block 54. The pawl 55 is relieved or provided with a curved surface 57 at the upper corner, in order to permit the pawl 55 to pivot in one direction. The pawl 55 is provided at the lower end thereof with a tapered tooth 58 for engaging the ratchet teeth 50 on the ratchet wheel 49 and integral with the block 54 but offset transversely and axially from the pawl 55 is a second pawl 59 which is integral with the block 54 or rigidly attached thereto. The pawl 59 is provided at the lower end thereof with a tapered tooth 60 and the distance between the teeth 58 and 60 is substantially equal to the distance between adjacent ratchet teeth 50 on the ratchet wheel 49. The block 54 is provided with a recess 61 in the upper surface thereof for receiving the lower end 62 of a lever 63 pivoted at 64 on the boss 51 of the hub 50'. The opposite end 65 of the lever 63 may be operated by a mechanism to be described for moving the block 54 in the recess 52 to actuate the escapement mechanism. It is to be noted, that the block 54 is provided with a recess 66 rearwardly of the pawl 55 and in alignment with the rearwardly disposed pawl 59 and this recess 66 is provided to permit the ratchet teeth 50 of the ratchet wheels 49 to move rearwardly upon forward movement of the block 54 during operation of the escapement mechanism 53.

Mechanism is provided for operating the escapements 53 in response to operation of one or more of the keys 15 on the apparatus and a portion of this mechanism may take the form of a ring 67 surrounding the hub 50' of each character spacing unit 48 and the ring 67 is secured in any suitable manner to the base 41, in order to prevent movement of the ring 67. Slidably and rotatably received within the ring 67 and surrounding the hub 50' of the ratchet wheel 49 is a thimble 68 having a barrel portion 69 extending within the ring 67 and the barrel portion 69 is provided with a plurality of angularly disposed cam slots 70 therein. The ring 67 carries a plurality of pins 71 engaging in the cam slots 70 and there is a further cam slot 72 provided in the ring 67 which serves to slidably receive an elongated pin 73 secured to the barrel 69 of the thimble 68 and projecting outwardly from the ring 67 a sufficient distance to permit attachment thereto of a link or flexible member which is utilized to operate each character spacing unit 58. This operating linkage will be later described. The thimble 68 is provided with a flared annnular flange 74, which upon axial movement of the thimble 68 serves to engage the outer end 65 of the lever 63 to move the block 54 of the escapement 53 in the recess 52 of the boss 51. Axial movement of the thimble 68 within the ring 67 is accomplished by moving the pin 73 up or down, as viewed in Fig. 8, which results in the pins and cam slots moving the thimble 68 to the left or right, as viewed in Fig. 8. It is to be noted, that each ratchet wheel 49 is provided with a pawl 75 pivotally mounted at 76 and provided with a tapered portion 77 and the purpose of this pawl 75 will be later described.

The arrangement of the character spacing units 48 in the apparatus of this invention is best shown in Figs. 6 and 7 and with particular reference to these figures, there is a first ratchet wheel 78 received on the shaft 46 and ratchet wheel 78 is provided with a hub 79 which is fixed to the shaft 46 by a pin or other suitable means 80. Surrounding the first ratchet wheel 78 is a character spacing unit A which comprises merely a ring 67 together with a thimble 68 and immediately following this assembly is a complete character spacing unit 48 including a ratchet wheel 49 together with the associated escapement and escapement operating mechanism described above. The ring 67 and thimble 68 of the character spacing unit A cooperates with a lever 63 on the next succeeding character spacing unit 48 which has been designated as B to permit movement of the first character spacing ratchet wheel 78 and the shaft 46 a distance corresponding to the distance between two adjacent teeth on the character spacing wheel 48. This rotation of shaft 46 and the pinion 47 carried thereby will, of course, result in the carriage of the apparatus moving a corresponding distance.

As shown in Figs. 6 and 7, there are eleven character spacing units received on the shaft 46 and each one of these serves to operate an escapement which cooperates with and engages the teeth on the preceding ratchet wheel 49 which upon actuation of such escapement results in rotating the shaft 46 and all of the previous character spacing units the distance between two adjacent teeth on the particular character spacing wheel 49 with which the escapement being operated, engages. A twelfth character spacing unit in the form of a ratchet wheel 81 is received on the shaft 46 adjacent the bearing block 43 and an escapement 82 is carried by the bearing block 43 and cooperates with the ratchet wheel 81. Operation of the escapement 82 serves to permit the ratchet wheel 81 and all of the character spacing units 48 on the shaft 46 to revolve together with the shaft 46, a distance equal to the spacing of the teeth on the ratchet wheel 81.

Since during operation of the machine, the character spacing units 48 will move different angular distances depending upon which characters are utilized and upon how many times the same character is utilized and consequently, it is necessary that upon completion of the forward movement of the carriage and return thereof to original position, that all of the ratchet wheels 49 of the character spacing units 48 be also returned to original position upon rearward movement of the carriage. This operation is accomplished by the spring pressed pawls 75 on the character spacing ratchet wheels 49, the teeth 77 of such pawls engaging the keyway 47 in the shaft 46 as the same is moved rearwardly by rearward movement of the carriage, whereby all of the character spacing units 48 will be moved to original position upon completion of the rearward movement of the carriage.

While the construction and operation of the escapement 53 is conventional and is similar to that commonly employed in conventional typewriters, a brief description of the operation of this escapement will be given. Assuming the block 54 to be retracted in the recess 52, one of the ratchet teeth 50 on the ratchet wheel 49 will engage the flat face of the pivoted pawl 55 and consequently, the ratchet wheel 49 will be held from rotation. Projection of the block 54 by operation of the lever 63 will result in the ratchet tooth in engagement with the pawl 55 moving rearwardly into the recess 66 and upon disengagement from the pawl 55, the ratchet wheel 49 will move until the tooth previously engaged with the pawl 55 engages the flat face of the fixed pawl 59. This results in movement of the ratchet wheel 49, a distance equal to the distance adjacent ratchet teeth 50. After this movement, retraction of the block 54 results in the next tooth 50 engaging the pawl 55 to prevent further rotation of the ratchet wheel 49. Rotation of the ratchet wheel 49 in the opposite direction is, of course, permitted by the pivotal mounting of the pawl 55.

In order to operate each of the pins 73 in the character spacing units 48 to produce a resultant movement of the carriage, there may be provided a plurality of rock shafts 83 mounted on the frame 10 and there is one of these rock shafts, as shown in Fig. 6, for each of the spacing units 48. These rock shafts 83 extend beneath the character spacing units 48 on the shafts 46 and a portion 84 of each shaft 43 is splined, as shown at 84 in Fig. 6, and likewise, in Fig. 19, and mounted on this splined portion 84 of each shaft 83 is an arm 85 which may be connected by a flexible member or link 86 with the pin 73 on the associated character spacing unit 48. Consequently, upon pivotal movement of the rock shaft 83, the connected pin 73 will be actuated through the arm 85 and this operation will take place, even though the base 41 may move axially of the rock shaft 83 for a purpose to be later described.

As best shown in Fig. 20, each rock shaft 83 is provided with a downwardly extending lip 87 and below each rock shaft 83 is a rod 88 mounted in the base 10, each rod serving to support a plurality of pivotally mounted fingers 89 which are adapted to engage a lip 87 and upon pivotal movement of the fingers 89 serve to move the rock shaft 83 and the arm 85 carried thereby. Each finger 89 is connected by a link or suitable flexible element 90 with one arm 91 of a bell crank lever 92 which is pivotally mounted at 93 on a bar carried by the frame 10. The other arm 94 of the bell crank lever 92 is provided, on its under side, with a V-shaped groove 95, as best shown in Fig. 20. A rocker arm 96 is pivotally mounted on a bar 97 secured to the frame 10 and the rocker arm 96 is provided at one end with a portion 98 having a V-shaped upper surface intended to engage in and mate with the V-shaped groove in the bell crank lever 92. The opposite end 100 of the rocker arm 96 is connected by a suitable link or flexible element 101 with the key bar 16.

As will be seen from an inspection of Figs. 20 and 21, there is provided one rocker arm 96 for each key bar 16 and adjacent rocker arms 96 are separated by collars 102. There are two bell crank levers 92 for each rocker arm 96 and, as shown in Fig. 21, the entire rocker arm assembly is urged toward the left by a compression spring 103 received around the bar 97 and bearing against the end collar 102 and the frame 10. In this position, the rocker arms 96 will engage the left hand bell crank lever 92 of each pair. In order to move the rocker arm assembly toward the right, as viewed in Fig. 21, there may be provided a pair of collars 104 and 105 on one end of the bar 97, these collars being spaced apart to receive a yoke 106 on the end of a lever 107 which may be pivotally mounted at 108 on the frame 10 and this lever 107 in turn is actuated by the shift keys 17 on the apparatus. Consequently, when it is desired to print lower case letters, the rocker arm assembly will be in the position, as shown in Fig. 21, and upon depression of the shift keys 17 to print upper case letters, the rocker arm assembly will be moved toward the right against the action of compression spring 103 resulting in engagement of the rocker arms 96 with the right hand bell crank lever 92 of each pair.

The above described linkage arrangement is shown diagrammatically in Fig. 19, and as will be seen, depression of any one of the key bars 16 will result in operating the type bar 19 and, at the same time, will actuate the rocker arm 96 to cause the end 98 thereof, to engage the appropriate bell crank lever 92, thereby operating the finger 89 which in turn engages the lip 87 on the rock shaft 83 thereby actuating the associated pin 73 to operate the associated escapement 53 and cause rotation of the shaft 46 which in turn permits advancement of the carriage one space, as required by the particular character being printed. The escapement 82 for the end or last ratchet wheel 81 is operated from a rock shaft 83 through a bell crank lever 109 mounted on the base 41. The V-shaped notches 95 in the bell crank levers 92 and the V-shaped surface 99 on the rocker arms 96 are provided for the purpose of eliminating the necessity of accurate alignment between the rocker arms and the bell crank levers upon actuation of the shift keys, since with this arrangement, partial movement of the rocker arm assembly and actuation of the shift keys will result in completing the alignment between these two elements due to the inter-action of the tapered surfaces on such two elements.

Since it is desirable to provide means whereby errors may be corrected, a back spacing mechanism has been included and the details of such mechanism are shown in Fig. 16. Such mechanism may well comprise a lever 110 pivotally mounted at 111 below the shaft 46 and it is to be noted, that there will be provided a lever 110 and associated mechanism for each character spacing unit 48. Pivotally mounted on the lever 110 at each side of the pivot point 111 and extending upwardly from the lever 110 are elongated pawls 112 and 113 and these pawls are provided with teeth 114 and 115 respectively, for engaging the teeth 50 on the ratchet wheels 49. The pawls 112 and 113 are normally urged toward the ratchet wheels 49 by a tension spring 116 connected between the pawls 112 and 113.

Pivotally mounted between the pawls 112 and 113 on a shaft 117 is an elongated cam 118 which, as shown in full lines in Fig. 16, is in position to hold the pawls 112 and 113 apart and out of engagement with the teeth 50 on the ratchet wheels 49. The shaft 117 and cams 118 carried thereby are actuated by a back spacing key on the apparatus to move the cams 118 into the dotted line positions shown in Fig. 16, at which time, the pawls 112 and 113 are moved into engagement with the teeth 50 on the ratchet wheels 49 by the action of tension spring 116.

The end of lever 110 is connected through a suitable link or flexible element 119 with an arm 120 slidably but non-rotatably mounted on splined portion 84 of each rock shaft 83 and consequently, upon operation of the rock shaft 83, the lever 110 will be actuated to move the pawl 112 upwardly and the pawl 113 downwardly and with the cam 118 in the dotted line position shown in Fig. 16, the teeth 114 and 115 in the pawls 112 and 113 will engage the teeth 50 on the ratchet wheels 49 and rotate these wheels in a reversed direction. The amount of rotation of the ratchet wheels 49 is determined by an adjustable stop comprising a screw threaded abutment 121 received in a portion of the base 41 and the abutment 121 may be adjusted to allow a suitable movement of the lever 110. The lever 110 may be returned to original position by compression spring 122 engaging such lever and the portion of the base 41.

In order to operate the back spacing mechanism, above described, it is only necessary to depress the back spacer key which results in moving the cams 118 to the dotted line position shown in Fig. 16, and thereafter the appropriate key bar 16 is actuated which results in moving the lever 110 and the pawls 112 and 113 attached thereto to move the carriage rearwardly the distance corresponding to the spacing of the character which was erroneously depressed.

It is to be understood, that the back spacing mechanism, above described and shown in Fig. 16, will be installed between each character spacing unit 48 and that, consequently, there will be a back spacing unit for each character, or group of characters which is connected to and associated with each back spacing unit. In this way, the carriage may be moved rearwardly a distance corresponding to the spacing of any desired characters.

Since it is necessary that each line be justified in order that all lines will end at the same point, there is provided justifying mechanism which, as best shown in Figs. 6, 17 and 18, comprises a drum 123 rotatably mounted on the frame 10 of the apparatus and with the axis of

such drum 123 substantially perpendicular to the direction of motion of the base 41 on the slides 43. It is to be noted, that during normal spacing movements of the carriage, by reason of actuation of the character spacing unit 48, as described above, that the base 41 remains stationary and it is only upon actuation of the space bar 18 that the base 41 moves and during such movement, the shaft 46 remains stationary and the carriage moves by reason of movement of the entire shaft 46 and pinion 47. Movement of the carriage 41 on actuation of the space bar 18 is controlled by a mechanism to be described in conjunction with the drum 123 forming a portion of the justifying mechanism.

The drum 123 is provided on the peripheral surface thereof with a plurality of spirally disposed ratchet teeth 124 and it is to be noted, that the ends of such teeth are separated by a keyway 125 in the surface of the drum. It is further to be noted, that the teeth 124 vary in pitch from one end to the other, and also that each succeeding tooth has a different pitch from the preceding tooth. In other words, there are provided a plurality of ratchet teeth 124, each tooth of which varies in pitch from one end to the other, and in which all of the teeth vary in pitch from each other. At one end of the drum 123 there is provided a spiral spring 126, one end of which 127 is secured to the drum 123 and the other end 128 is secured to the frame 10. Consequently this spiral spring 126 tends to urge the drum 123 in one direction and rotation of the drum against the action of spring 126 will serve to wind or tighten the same and in order to hold the drum 123 in an advanced position, there is provided a brake in the form of a bar 129 pivotally mounted at 130 on the frame 10 and having a shoe 131 for engaging the surface of the drum 123. The shoe 131 of the brake arm 129 is normally urged into engagement with the surface of the drum 123 by a compression spring or other suitable means 132 engaging the bar 129 and the portion of the frame 10. The shoe 131 may be moved away from the surface of the drum 123 by a link or flexible member 133 connected to the bar 129 and to a justifying key 134 on the front of the apparatus adjacent the keyboard. It is to be noted, that the drum 123 is so positioned that the base 41 may move thereover during sliding movements of such base 41.

In order to control movement of the base 41 upon operation of the space bar 18, there is provided an escapement mechanism 135 which cooperates with the ratchet teeth 124 on the drum 123 and the details of this escapement mechanism are shown in Figs. 22 to 26. With particular reference to these figures, there is provided a pair of slidable dogs 136 and 137 which are slidably mounted in the base 41 and it is to be noted, that the dog 136 is provided at the lower end thereof, with a tapered tooth 138 which projects below the lower surface of the base 41 into engagement with the teeth 124 on the drum 123. As shown in Fig. 25, the lower end of the slidable dog 136 is cut away, as shown at 139 for a purpose to be presently described. The slidable dog 137 is mounted in the base 41 at one side of the dog 136 and the dog 137 is provided with a tapered lower end 140 for engaging the teeth 124 on the drum 123. Dog 136 is provided at its upper end with a cross bar 141 in which is provided an aperture 142 and on the upper end of the dog 137 is a cross bar 143 having an aperture 144. The aperture 142 in the cross bar 141 serves to slidably receive a pin 145 secured in the base 41 and between a head 146 on the pin 145 and the cross bar 141, there is positioned a compression spring 147 which normally urges the dog 136 and tapered lower end 138 thereof into engagment with the teeth 124 on the drum 123.

Similarly the aperture 144 in the cross bar 143 of the dog 137 is slidably received on a pin 148 fixed to the base 41 and between a head 149 on the pin 148 and the cross bar 143, there is positioned a compression spring 150 which normally urges the tapered lower end 140 into engagement with the teeth 124 on the drum 123.

In order to actuate the dogs 136 and 137, there is provided a cam 151 pivotally mounted on the base 41 and this cam is provided with a lobe 152 cooperating with the cross bar 143 and with a lobe 153 cooperating with the cross bar 141. An operating arm 154 is secured to the cam 151 and such operating arm 154 may be connected through a suitable link or flexible member 155 with the space bar 18.

Operation of the arm 154 by the space bar 18 will result in moving the cam 151 to raise the dog 137 thereby disengaging the lower end 140 thereof from a tooth 144 on the drum 123 and consequently, the base 41 will move forwardly until the lower end 138 of the dog 136 engages the next tooth 124 on the drum 123 and prevents further movement of the base 41. The cutaway portion on the dog 136 permits the base 41 to move slightly more than the distance between adjacent teeth 124 on the drum 123, whereby proper operation of the dogs 136 and 137 and the well known manner of this type of escapement, is permitted. It will therefore, be seen, that spacing movements of the carriage will be controlled by the distance between adjacent teeth on the drum 123 and that such spacing movements may be varied by rotation of the drum 123 to different positions, in order to provide different tooth spacing.

In normal operation of the photocomposing apparatus above described, it is assumed that the drum 123 will be set at zero or some suitable preselected position and that a line will be typed on the tape 39 with the slide 26 closed to prevent exposure of the photographic film 12. The character spacing in the line will be determined by operation of the character spacing units 48 and the spacing between words will be determined by the spacing of the teeth being utilized on the drum 123. When the end of the line is reached and in order to justify the same, the justifying key 134 will be actuated, which in turn will release the brake shoe 131 from the surface of the drum 123 and due to the fact, that the base 41 is urged forwardly on the slides 43 by the action of the carriage, the drum 123 will then rotate to permit movement of the carriage to the end of the line. This will result in bringing another portion of the teeth 124 on the drum 123 into engagement with the escapement mechanism 135 and since the pitch of the teeth 124 change, upon rotation of the drum 123, it will be seen that this movement of the drum will result in providing the proper spacing to justify the lines of characters.

The justifying key 134 is then released to permit engagement of the brake shoe 131 with the surface of the drum 123, which holds such drum in the position determined by the remaining length of lines and the slide 26 is then actuated to open the aperture 27, at which time the line is re-typed and due to the fact, that the pitch of the teeth 124 on the drum 123 has been changed, the spaces between words will be enlarged or contracted in accordance with the number of words in the line, to justify the same and end the line at the same predetermined point. Since the aperture 27 in the slide 26 is open, this will result in exposing the photographic film 12, by reason of the fact, that each type bar 19 is provided with an upstanding frame 156, which serves to carry a transparent character outline 157 which may be of the lower case variety and an upper case outline 158. Of course, the character outlines may be varied, as desired. As a result of this arrangement, the character outlines 157 or 158 depending upon whether or not the shift key 17 is depressed, will be disposed in the path of the light beam 29 and since such light beam will pass through the transparent character outline, the same will be projected onto the surface of the photographic film 12 resulting in exposing of such film and upon proper de-

velopment thereof, the character will, of course, appear on the film.

There has thus been provided a photocomposing apparatus in which a line may first be typed on a tape 39 and after justification of such line, the apparatus may be operated to suitably expose a photographic film. As described above, the spacing for each character is determined in accordance with the size of that character and likewise, there has been provided, as fully described above, a justifying mechanism for justifying each line of printing.

Also, as described above, there has been provided back spacing mechanism which permits correction of an error and also permits back spacing in accordance with the proper spacing of the character erroneously actuated. As will be seen, the photocomposing apparatus of this invention is relatively compact and since the degree of accuracy of the character spacing and the word spacing depends, almost entirely, on the cooperating ratchet teeth and escapement mechanisms and since these mechanisms are subject to very little wear, the accuracy of the apparatus will be maintained over a long period of time. The various control lever and linkage systems utilized in this apparatus are of relatively simple construction and, consequently, maintenance work is reduced to a minimum.

It should also be noted that by changing the pinion gear 47 and the lens system 35 that various point sizes could be obtained and, furthermore, any desired type face may be provided on the type bars.

As mentioned above, this apparatus may be easily adapted to permit "kerning" which allows selective reduction of intercharacter spacing, so that when the conformation of adjacent characters is such as would ordinarily result in the illusion that some characters were more widely spaced than others, such characters may be caused to "kern" and thus produce the appearance of even spacing.

This kerning operation may be accomplished by providing an additional ratchet wheel on the shaft 46 and by providing a mechanism similar to the back spacing mechanism shown in Fig. 16, in which case the cam 118 would be operated by a kerning key provided on the keyboard of the apparatus, upon the actuation of which, the operation of another key to actuate the kerning back spacing mechanism would result in moving the carriage rearwardly an amount proportionate to the character spacing desired and thereby provide the appearance of uniform spacing for all of the characters. This particular kerning mechanism is not disclosed or described in detail in this application but, as stated above, the same may be incorporated in the machine of this invention with little modification.

This invention also contemplates the provision of justifying apparatus for a typewriter and such apparatus is shown in Fig. 27 in conjunction with a typewriter 159 having a frame 160 and provided with the usual keys 161 mounted on key bars 162, shift keys 163 and a space bar 164. The keys 161 and 162 serve to operate type bars, not shown, in the conventional manner. The typewriter 159 is provided with the usual carriage 165 having a platen 166 for receiving and feeding a sheet of paper and there may be also provided a left hand marginal stop 167 which may be adjustably positioned to indicate the desired point at which a properly justified line should end.

Mounted on the rear of the typewriter 159 and secured to the frame 160 is a platform 168 which serves to slidably support an extensible and retractable carriage control unit 169 slidably mounted on the platform 168.

The carriage control unit 169 may conveniently comprise a spacing slide 170 and a plurality of character slides 171, 172, 173, 174, 175 and 176, all telescopically related. Character slide 176 is connected by an arm 177 with the carriage 165 and movement of the carriage 165 toward the right, as viewed in Fig. 27, will result in extending the carriage control unit 169 to full length, as shown in Fig. 27, and movement of the carriage 165 toward the left is controlled by such control unit 169 in a manner to be presently described.

Each character slide is provided in its upper surface with ratchet teeth 178 and the pitch of such teeth are different for each slide. The pitch of such teeth are determined by the character spacing of the characters to be utilized and the character slide utilized for such spacing will be determined by the particular key 161 which is actuated. The spacing slide 170 is provided with an escapement mechanism 179 which cooperates with the ratchet teeth 178 on the character slide 171 and similarly each slide 171, 172, 173, 174 and 175 are provided with escapement mechanisms 179 which cooperate with the teeth on the next smaller character slide. Each escapement mechanism is provided with an actuating cam 180 provided with a laterally projecting arm 181 and each of these arms 181 project into the path of movement of an elongated tab 182 fixed to a rock shaft 183 mounted in upstanding brackets 184 attached to the platform 168. It is to be noted, that there is a rock shaft 183 for each escapement mechanism 179.

The rock shaft 183 are operated through suitable links or flexible elements 185 which in turn are attached to rock shaft 186 mounted in downwardly extending brackets 187 attached to the platform 168 and the rock shafts 186 are provided with ears 188 fixed thereto which are engaged by pins 189 mounted on push rods 190. Push rods 190 in turn are operated by links or suitable flexible elements 191 by operation of the keys 161 and key bars 162 and it is to be noted, that there is one push rod 190 for each key bar 162. The ears 188 will be provided on apropriate rock shafts 186 in order to provide the proper spacing for characters being utilized and whereby the proper escapement 179 will be actuated to permit movement of the appropriate character slide thereby producing the proper movement of the carriage 165 and proper spacing printed on the paper carried thereby.

Rotatably mounted on the platform 168 is a character spacing drum 192 and the axis of this drum is substantially parallel to the axis of the carriage control unit 169. The drum 192 is provided with a spirally disposed, variable pitch ratchet teeth 193 in the same manner, as described above, in connection with the photocomposing appaartus and the drum 192 is urged in one direction by a similar spiral spring or other suitable equivalent means and such drum 192 is held in position by a brake mechanism controlled by a justifying key 194 on the front of the typewriter 159 adjacent the keyboard. As in the photocomposing apparatus, above described, the ratchet teeth 193 on the justifying drum 192 controls the spacing between words and for this purpose, there is provided on the spacing slide 170 an escapement mechanism 195 having an actuating cam 196 provided with a laterally extending operating arm 197 disposed in the path of movement of a tab 198 fixed to a rock shaft 199 supported in the brackets 184. The rock shaft 199 is actuated through a suitable link or cable 200 by the space bar 164.

In operation, the justifying drum 192 will be set at zero position and a dummy line typed which will result in providing the total number of character spaces, as well as word spaces and upon reaching the end of the line the justifying key 194 will be operated to release the brake on the drum 192, at which time, the drum will be rotated by the force of the escapement 195 exerted on the teeth 193 thereby permitting movement of the carriage toward the left to the position indicated by the marginal stop 167. Release of the justifying key 194 permits application of the brake to the drum 192 thereby holding the drum in adjusted position and since the teeth 193 are provided with a variable pitch, as fully described above, this will result in automatically justifying the line of printing and such line is thereafter typed on the paper and the spaces between words is determined by the pitch

of the teeth **193** on the drum **192** thereby providing a properly justified line which terminates, as indicated by the marginal stop **167**.

The above described justifying apparatus is extremely effective and accurate in operation and, as described, may be conveniently incorporated in a conventional typewriter. A high degree of accuracy by reason of the fact, that the only wear points which will effect the spacing is the teeth on the spacing slides and the teeth on the drum **192** as well as the dogs of each escapement. Since these parts may be suitably hardened, wear is reduced to a minimum and suitable accuracy will be maintained over a long period of time.

It will be obvious to those skilled in the art that various changes may be made in the invention without departing from the spirit and scope thereof and therefore the invention is not limited by that which is shown in the drawing and described in the specification, but only as indicated in the appended claims.

What is claimed is:

1. A photocomposing apparatus comprising a frame, a carriage slidably mounted on said frame, a photographic film magazine on said carriage, means for intermittently feeding film from said magazine, a lightproof housing enclosing film fed from said magazine, said housing having an aperture to admit light rays to a limited area of said film to expose the same, a shutter for momentarily opening and closing said aperture, a light source providing a light beam focused on said aperture, a plurality of type bars pivotally mounted on said frame, a type face on each type bar, a transparent character outline mounted on each type bar, a plurality of finger engaging keys providing a keyboard for actuating said type bars to move said character outline into alignment with said aperture and light beam, shutter operating mechanism operable by said type bars to actuate said shutter and expose said film to provide an image of said character thereon, a paper tape, means for feeding said tape in juxtaposition to said type bars in operative position whereby each type face prints a character on said tape, a shift key and a space bar on said keyboard, a rack bar on said carrige, mechanism for controlling step by step forward movements of said carriage in accordance with the widths of characters to be printed and the spaces between words, said mechanism comprising a base slidably mounted on said frame for movement parallel to the movement of said carriage, a shaft rotatably mounted on said base, a pinion fixed to said shaft and meshing with said rack bar, a keyway in said shaft, a first character ratchet wheel fixed to said shaft adjacent one end, a plurality of additional character ratchet wheels rotatably mounted on said shaft, a last character ratchet wheel rotatably mounted on said shaft adjacent the opposite end, the teeth on each wheel having a pitch different from the teeth on other wheels, the pitch of the teeth on each wheel corresponding to the width of a character or group of characters on said type bars, an escapement mechanism carried by each additional wheel and cooperating with the teeth on the next preceding wheel to control step by step rotation of all preceding wheels and said shaft to advance said carriage step by step in accordance with the pitch of the teeth on said next preceding wheel, a last escapement mounted on said frame and cooperating with said last wheel to control the step by step rotation of all of said wheels and said shaft and the resulting movement of said carriage, a pawl on each additional wheel and said last wheel, said pawls permitting rotation of said wheels relative to said shaft in one direction and engageable with said keyway upon rotation of said shaft by the return movement of said carriage to return said wheels to starting position, a ring surrounding each wheel and fixed against rotation, an escapement actuating thimble slidably mounted in each ring, cam means for moving each thimble axially to actuate each escapement, a plurality of rock shafts mounted on said frame, an arm slidably and non-rotatably mounted on each rock shaft, means connecting each arm with one of said cam means, means connecting said rock shafts and said keys to operate said rock shafts in response to operation of said keys, a justifying drum rotatably mounted on said frame, a plurality of spirally disposed ratchet teeth on said drum, the pitch of said last named teeth continuously increasing from one end of said drum to the other, a spacing escapement on said base and cooperating with the teeth on said drum to control the step by step movement of said base in accordance with the pitch of the teeth on said drum, spring means for rotating said drum in one direction, a brake for preventing rotation of said drum, a manually operable key for releasing said brake and linkage means operable by said space bar to actuate said spacing escapement whereby upon determining the number of character spaces and word spaces in a line of printing said drum may be rotated to provide the proper pitch of the teeth thereon in engagement with said spacing escapement to justify such line of printing.

2.. A photocomposing apparatus comprising a frame, a carriage slidably mounted on said frame, a photographic film magazine on said carriage, means for intermittently feeding film from said magazine, a lightproof housing enclosing film fed from said magazine, said housing having an aperture to admit light rays to a limited area of said film to expose the same, a shutter for momentarily opening and closing said aperture, a light source providing a light beam focused on said aperture, a plurality of type bars pivotally mounted on said frame, a type face on each type bar, a transparent character outline mounted on each type bar, a plurality of finger engaging keys providing a keyboard for actuating said type bars to move said character outline into alignment with said aperture and light beam, shutter operating mechanism operable by said type bars to actuate said shutter and expose said film to provide an image of said character thereon, a shift key and a space bar on said keyboard, a rack bar on said carriage, mechanism for controlling step by step forward movements of said carriage in accordance with the widths of characters to be printed and the spaces between words, said mechanism comprising a base slidably mounted on said frame for movement parallel to the movement of said carriage, a shaft rotatably mounted on said base, a pinion fixed to said shaft and meshing with said rack bar, a keyway in said shaft, a first character ratchet wheel fixed to said shaft adjacent one end, a plurality of additional character ratchet wheels rotatably mounted on said shaft, a last character ratchet wheel rotatably mounted on said shaft adjacent the opposite end, the teeth on each wheel having a pitch different from the teeth on other wheels, the pitch of the teeth on each wheel corresponding to the width of a character or group of characters on said type bars, an escapement mechanism carried by each additional wheel and cooperating with the teeth on the next preceding wheel to control step by step rotation of all preceding wheels and said shaft to advance said carriage step by step in accordance with the pitch of the teeth on said next preceding wheel, a last escapement mounted on said frame and cooperating with said last wheel to control the step by step rotation of all of said wheels and said shaft and the resulting movement of said carriage, a pawl on each additional wheel and said last wheel, said pawls permitting rotation of said wheels relative to said shaft in one direction and engageable with said keyway upon rotation of said shaft by the return movement of said carriage to return said wheels to starting position, a ring surrounding each wheel and fixed against rotation, an escapement actuating thimble slidably mounted in each ring, cam means for moving each thimble axially to actuate each escapement, a plurality of rock shafts mounted on said frame, an arm slidably and non-rotatably mounted on each rock shaft, means connecting each arm with one of said cam means, means connecting said rock shafts and said keys to operate said rock shafts in

response to operation of said keys, a justifying drum rotatably mounted on said frame, a plurality of spirally disposed ratchet teeth on said drum, the pitch of said last named teeth continuously increasing from one end of said drum to the other, a spacing escapement on said base and cooperating with the teeth on said drum to control the step by step movement of said base in accordance with the pitch of the teeth on said drum, spring means for rotating said drum in one direction, a brake for preventing rotation of said drum, a manually operable key for releasing said brake and linkage means operable by said space bar to actuate said spacing escapement whereby upon determining the number of character spaces and word spaces in a line of printing said drum may be rotated to provide the proper pitch of the teeth thereon in engagement with said spacing escapement to justify such line of printing.

3. A photocomposing apparatus comprising a frame, a carriage slidably mounted on said frame, a photographic film magazine on said carriage, means for intermittently feeding film from said magazine, a lightproof housing enclosing film fed by said magazine, said housing having an aperture to admit light rays to a limited area of said film to expose the same, a shutter for momentarily opening and closing said aperture, a light source providing a light beam focused on said aperture, a plurality of type bars pivotally mounted on said frame, a type face on each type bar, a transparent character outline mounted on each type bar, a plurality of finger engaging keys providing a keyboard for actuating said type bars to move said character into alignment with said aperture and light beam, shutter operating mechanism operable by said type bars to actuate said shutter and expose said film to provide an image of said character thereon, a shift key and a space bar on said keyboard, a rack bar on said carriage, mechanism for controlling step by step forward movements of said carriage in accordance with the widths of characters to be printed and the spaces between words, said mechanism comprising a base slidably mounted on said frame for movement parallel to the movement of said carriage, a shaft rotatably mounted on said base, a pinion fixed to said shaft and meshing with said rack bar, a keyway in said shaft, a first character ratchet wheel fixed to said shaft adjacent one end, a plurality of additional character ratchet wheels rotatably mounted on said shaft, a last character ratchet wheel rotatably mounted on said shaft adjacent the opposite end, the teeth on each wheel having a pitch different from the teeth on other wheels, the pitch of the teeth on each wheel corresponding to the width of a character or group of characters on said type bars, an escapement mechanism carried by each additional wheel and cooperating with the teeth on the next preceding wheel to control step by step rotation of all preceding wheels and said shaft to advance said carriage step by step in accordance with the pitch of the teeth on said next preceding wheel, a last escapement mounted on said frame and cooperating with said last wheel to control the step by step rotation of all of said wheels and said shaft and the resulting movement of said carriage, a pawl on each additional wheel and said last wheel, said pawls permitting rotation of said wheels relative to said shaft in one direction and engageable with said keyway upon rotation of said shaft by the return movement of said carriage to return said wheels to starting position, means to actuate each escapement, a plurality of rock shafts mounted on said frame, an arm slidably and non-rotatably mounted on each rock shaft, means connecting each arm with one of said escapement actuating means, means connecting said rock shafts and said keys to operate said rock shafts in response to operation of said keys, a justifying drum rotatably mounted on said frame, a plurality of spirally disposed ratchet teeth on said drum, the pitch of said last named teeth continuously increasing from one end of said drum to the other, a spacing escapement on said base and cooperating with the teeth on said drum to control the step by step movement of said base in accordance with the pitch of the teeth on said drum, spring means for rotating said drum in one direction, a brake for preventing rotation of said drum, a manually operable key for releasing said brake and linkage means operable by said space bar to actuate said spacing escapement whereby upon determining the number of character spaces and word spaces in a line of printing said drum may be rotated to provide the proper pitch of the teeth thereon in engagement with said spacing escapement to justify such line of printing.

4. A photocomposing apparatus comprising a frame, a carriage slidably mounted on said frame, a photographic film magazine on said carriage, means for intermittently feeding film from said magazine, a lightproof housing enclosing film fed from said magazine, said housing having an aperture to admit light rays to a limited area of said film to expose the same, a shutter for momentarily opening and closing said aperture, a light source providing a light beam focused on said aperture, a plurality of type bars pivotally mounted on said frame, a type face on each type bar, a transparent character outline mounted on each type bar, a plurality of finger engaging keys providing a keyboard for actuating said type bars to move said character outline into alignment with said aperture and light beam, shutter operating mechanism operable by said type bars to actuate said shutter and expose said film to provide an image of said character thereon, a shift key and a space bar on said keyboard, a rack bar on said carriage, mechanism for controlling step by step forward movements of said carriage in accordance with the widths of characters to be printed and the spaces between words, said mechanism comprising a base slidably mounted on said frame for movement parallel to the movement of said carriage, a shaft rotatably mounted on said base, a pinion fixed to said shaft and meshing with said rack bar, a first character ratchet wheel fixed to said shaft adjacent one end, a plurality of additional character ratchet wheels rotatably mounted on said shaft, a last character ratchet wheel rotatably mounted on said shaft adjacent the opposite end, the teeth on each wheel having a pitch different from the teeth on other wheels, the pitch of the teeth on each wheel corresponding to the width of a character or group of characters on said type bars, an escapement mechanism carried by each additional wheel and cooperating with the teeth on the next preceding wheel to control step by step rotation of all preceding wheels and said shaft to advance said carriage step by step in accordance with the pitch of the teeth on said next preceding wheel, a last escapement mounted on said frame and cooperating with said last wheel to control the step by step rotation of all of said wheels and said shaft and the resulting movement of said carriage, means permitting rotation of said wheels relative to said shaft in one direction and engageable with said shaft upon rotation of said shaft by the return movement of said carriage to return said wheels to starting position, means to actuate each escapement, a pluraltiy of rock shafts mounted on said frame, an arm slidably and non-rotatably mounted on each rock shaft, means connecting each arm with one of said escapement actuating means, means connecting said rock shafts and said keys to operate said rock shafts in response to operation of said keys, a justifying drum rotatably mounted on said frame, a plurality of spirally disposed ratchet teeth on said drum to control the step by step movement of said base in accordance with the pitch of the teeth on said drum, spring means for rotating said drum in one direction, a brake for preventing rotation of said drum, a manually operable key for releasing said brake and linkage means operable by said space bar to actuate said spacing escapement whereby upon determining the number of character spaces and word spaces in a line of printing said drum may be rotated to provide the

proper pitch of the teeth thereon in engagement with said spacing escapement to justify such line of printing.

5. A photocomposing apparatus comprising a frame, a carriage slidably mounted on said frame, a photographic film magazine on said carriage, means for intermittently feeding film from said magazine, a lightproof housing enclosing film fed from said magazine, said housing having an aperture to admit light rays to a limited area of said film to expose the same, a shutter for momentarily opening and closing said aperture, a light source providing a light beam focused on said aperture, a plurality of type bars pivotally mounted on said frame, a type face on each type bar, a transparent character outline mounted on each type bar, a plurality of finger engaging keys providing a keyboard for actuating said type bars to move said character outline into alignment with said aperture and light beam, shutter operating mechanism operable by said type bars to actuate said shutter and expose said film to provide an image of said character thereon, a shift key and a space bar on said keyboard, a rack bar on said carriage, mechanism for controlling step by step forward movements of said carriage in accordance with the widths of character to be printed and the spaces between words, said mechanism comprising a base slidably mounted on said frame for movement parallel to the movement of said carriage, a shaft rotatably mounted on said base, a pinion fixed to said shaft and meshing with said rack bar, a first character ratchet wheel fixed to said shaft adjacent one end, a plurality of additional character ratchet wheels rotatably mounted on said shaft, a last character ratchet wheel rotatably mounted on said shaft adjacent the opposite end, the teeth on each wheel having a pitch different from the teeth on other wheels, the pitch of the teeth on each wheel corresponding to the width of a character or group of characters on said type bars, an escapement mechanism carried by each additional wheel and cooperating with the teeth on the next preceding wheel to control step by step rotation of all preceding wheels and said shaft to advance said carriage step by step in accordance with the pitch of the teeth on said next preceding wheel, a last escapement mounted on said frame and cooperating with said last wheel to control the step by step rotation of all of said wheels and said shaft and the resulting movement of said carriage, means permitting rotation of said wheels relative to said shaft in one direction and engageable with said shaft upon rotation of said shaft by the return movement of said carriage to return said wheels to starting position, means to actuate each escapement, a plurality of rock shafts mounted on said frame, means connecting each rock shaft with one of said escapement actuating means, means connecting said rock shafts and said keys to operate said rock shafts in response to operation of said keys, a justifying drum rotatably mounted on said frame, a plurality of spirally disposed ratchet teeth on said drum, the pitch of said last named teeth continuously increasing from one end of said drum to the other, a spacing escapement on said base and cooperating with the teeth on said drum to control the step by step movement of said base in accordance with the pitch of the teeth on said drum, means for rotating said drum in one direction, a brake for preventing rotation of said drum, a manually operable key for releasing said brake and linkage means operable by said space bar to actuate said spacing escapement whereby upon determining the number of character spaces and word spaces in a line of printing said drum may be rotated to provide the proper pitch of the teeth thereon in engagement with said spacing escapement to justify such line of printing.

6. A photocomposing apparatus comprising a frame, a carriage slidably mounted on said frame, a photographic film magazine on said carriage, a lightproof housing enclosing film fed from said magazine, said housing having an aperture to admit light rays to a limited area of said film to expose the same, a shutter for momentarily opening and closing said aperture, a light source providing a light beam focused on said aperture, a plurality of type bars pivotally mounted on said frame, a transparent character outline mounted on each type bar, a plurality of finger engaging keys providing a keyboard for actuating said type bars to move said character outline into alignment with said aperture and light beam, shutter operating mechanism operable by said type bars to actuate said shutter and expose said film to provide an image of said character thereon, a shift key and a space bar on said keyboard, a rack bar on said carriage, mechanism for controlling step by step forward movements of said carriage in accordance with the widths of characters to be printed and the spaces between words, said mechanism comprising a base slidably mounted on said frame for movement parallel to the movement of said carriage, a shaft rotatably mounted on said base, a pinion fixed to said shaft and meshing with said rack bar, a first character ratchet wheel fixed to said shaft adjacent one end, a plurality of additional character ratchet wheels rotatably mounted on said shaft, a last character ratchet wheel rotatably mounted on said shaft adjacent the opposite end, the teeth on each wheel having a pitch different from the teeth on other wheels, the pitch of the teeth on each wheel corresponding to the width of a character or group of characters on said type bars, an escapement mechanism carried by each additional wheel and cooperating with the teeth on the next preceding wheel to control step by step rotation of all preceding wheels and said shaft to advance said carriage step by step in accordance with the pitch of the teeth on said next preceding wheel, a last escapement mounted on said frame and cooperating with said last wheel to control the step by step rotation of all of said wheels and said shaft and the resulting movement of said carriage, means permitting rotation of said wheels relative to said shaft in one direction and engageable with said shaft upon rotation of said shaft by the return movement of said carriage to return said wheels to starting position, means to actuate each escapement, a plurality of rock shafts mounted on said frame, means connecting each rock shaft with one of said escapement actuating means, means connecting said rock shafts and said keys to operate said rock shafts in response to operation of said keys, a justifying drum rotatably mounted on said frame, a plurality of spirally disposed ratchet teeth on said drum, the pitch of said last named teeth continuously increasing from one end of said drum to the other, a spacing escapement on said base and cooperating with the teeth on said drum to control the step by step movement of said base in accordance with the pitch of the teeth on said drum, means for rotating said drum in one direction, a brake for preventing rotation of said drum, a manually operable key for releasing said brake and linkage means operable by said space bar to actuate said spacing escapement whereby upon determining the number of character spaces and word spaces in a line of printing said drum may be rotated to provide the proper pitch of the teeth thereon in engagement with said spacing escapement to justify such line of printing.

7. A photocomposing apparatus comprising a frame, a carriage slidably mounted on said frame, a photographic film magazine on said carriage, a lightproof housing enclosing film fed from said magazine, said housing having an aperture to admit light rays to a limited area of said film to expose the same, a shutter for momentarily opening and closing said aperture, a light source providing a light beam focused on said aperture, a plurality of type bars pivotally mounted on said frame, a transparent character outline mounted on each type bar, a plurality of finger engaging keys providing a keyboard for actuating said type bars to move

said character outline into alignment with said aperture and light beam, shutter operating mechanism operable by said type bars to actuate said shutter and expose said film to provide an image of said character thereon, a shift key and a space bar on said keyboard, a rack bar on said carriage, mechanism for controlling step by step forward movements of said carriage in accordance with the widths of characters to be printed and the spaces between words, said mechanism comprising a base slidably mounted on said frame for movement parallel to the movement of said carriage, a shaft rotatably mounted on said base, a pinion fixed to said shaft and meshing with said rack bar, a first character ratchet wheel fixed to said shaft adjacent one end, a plurality of additional character ratchet wheels rotatably mounted on said shaft, a last character ratchet wheel rotatably mounted on said shaft adjacent the opposite end, the teeth on each wheel having a pitch different from the teeth on other wheels, the pitch of the teeth on each wheel corresponding to the width of a character or group of characters on said type bars, an escapement mechanism carried by each additional wheel and cooperating with the teeth on the next preceding wheel to control step by step rotation of all preceding wheels and said shaft to advance said carriage step by step in accordance with the pitch of the teeth on said next preceding wheel, a last escapement mounted on said frame and cooperating with said last wheel to control the step by step rotation of all of said wheels and said shaft and the resulting movement of said carriage, means permitting rotation of said wheels relative to said shaft in one direction and engageable with said shaft upon rotation of said shaft by the return movement of said carriage to return said wheels to starting position, means connected to each key to actuate each escapement, a justifying drum rotatably mounted on said frame, a plurality of spirally disposed ratchet teeth on said drum, the pitch of said last named teeth continuously increasing from one end of said drum to the other, a spacing escapement on said base and cooperating with the teeth on said drum to control the step by step movement of said base in accordance with the pitch of the teeth on said drum, means for rotating said drum in one direction, a brake for preventing rotation of said drum, a manually operable key for releasing said brake and linkage means operable by said space bar to actuate said spacing escapement whereby upon determining the number of character spaces and word spaces in a line of printing said drum may be rotated to provide the proper pitch of the teeth thereon in engagement with said spacing escapement to justify such line of printing.

8. A photocomposing apparatus comprising a frame, a carriage slidably mounted on said frame, a photographic film magazine on said carriage, a lightproof housing enclosing film fed from said magazine, said housing having an aperture to admit light rays to a limited area of said film to expose the same, a shutter for momentarily opening and closing said aperture, a light source providing a light beam focused on said aperture, a plurality of type bars pivotally mounted on said frame, a transparent character outline mounted on each type bar, a plurality of finger engaging keys providing a keyboard for actuating said type bars to move said character outline into alignment with said aperture and light beam, shutter operating mechanism operable by said type bars to actuate said shutter and expose said film to provide an image of said character thereon, a shift key and a space bar on said keyboard, a rack bar on said carriage, mechanism for controlling step by step forward movements of said carriage in accordance with the widths of characters to be printed and the spaces between words, said mechanism comprising a base slidably mounted on said frame for movement parallel to the movement of said carriage, a shaft rotatably mounted on said base, a pinion fixed to said shaft and meshing with said rack bar, a first character ratchet wheel fixed to said shaft adjacent one end, a plurality of additional character ratchet wheels rotatably mounted on said shaft, the teeth on each wheel having a pitch different from the teeth on other wheels, the pitch of the teeth on each wheel corresponding to the width of a character or group of characters on said type bars, an escapement mechanism carried by each additional wheel and cooperating with the teeth on the next preceding wheel to control step by step rotation of all preceding wheels and said shaft to advance said carriage step by step in accordance with the pitch of the teeth on said next preceding wheel, means permitting rotation of said wheels relative to said shaft in one direction and engageable with said shaft upon rotation of said shaft by the return movement of said carriage to return said wheels to starting position, means connected to each key to actuate each escapement, a justifying drum rotatably mounted on said frame, a plurality of spirally disposed ratchet teeth on said drum, the pitch of said last named teeth continuously increasing from one end of said drum to the other, a spacing escapement on said base and cooperating with the teeth on said drum to control the step by step movement of said base in accordance with the pitch of the teeth on said drum, means for rotating said drum in one direction, a brake for preventing rotation of said drum, a manually operable key for releasing said brake and linkage means operable by said space bar to actuate said spacing escapement whereby upon determining the number of character spaces and word spaces in a line of printing said drum may be rotated to provide the proper pitch of the teeth thereon in engagement with said spacing escapement to justify such line of printing.

9. A photocomposing apparatus comprising a frame, a carriage slidably mounted on said frame, a photographic film magazine on said carriage, a lightproof housing enclosing film fed from said magazine, said housing having an aperture to admit light rays to a limited area of said film to expose the same, a shutter for momentarily opening and closing said aperture, a light source providing a light beam focused on said aperture, a plurality of type bars pivotally mounted on said frame, a transparent character outline mounted on each type bar, a plurality of finger engaging keys providing a keyboard for actuating said type bars to move said character outline into alignment with said aperture and light beam, shutter operating mechanism operable by said type bars to actuate said shutter and expose said film to provide an image of said character thereon, a shift key and a space bar on said keyboard, a rack bar on said carriage, mechanism for controlling step by step forward movements of said carriage in accordance with the widths of characters to be printed and the spaces between words, said mechanism comprising a base slidably mounted on said frame for movement parallel to the movement of said carriage, a shaft rotatably mounted on said base, a pinion fixed to said shaft and meshing with said rack bar, a first character ratchet wheel fixed to said shaft adjacent one end, a plurality of additional character ratchet wheels rotatably mounted on said shaft, the teeth on each wheel having a pitch different from the teeth on other wheels, the pitch of the teeth on each wheel corresponding to the width of a character or group of characters on said type bars, an escapement mechanism carried by each additional wheel and cooperating with the teeth on the next preceding wheel to control step by step rotation of all preceding wheels and said shaft to advance said carriage step by step in accordance with the pitch of the teeth on said next preceding wheel, means connected to each key to actuate each escapement, a justifying drum rotatably mounted on said frame, a plurality of spirally disposed ratchet teeth on said drum, the pitch of said last named teeth continuously increasing from one end of said drum to the other, a spacing escapement on said base and cooperating with the teeth on said drum to control the step by step movement of said base in accordance with the pitch of the teeth on said drum, means for rotating said drum in one direction, a

brake for preventing rotation of said drum, a manually operable key for releasing said brake and linkage means operable by said space bar to actuate said spacing escapement whereby upon determining the number of character spaces and word spaces in a line of printing said drum may be rotated to provide the proper pitch of the teeth thereon in engagement with said spacing escapement to justify such line of printing.

10. A photocomposing apparatus comprising a frame, a carriage slidably mounted on said frame, a photographic film magazine on said carriage, a lightproof housing enclosing film fed from said magazine, said housing having an aperture to admit light rays to a limited area of said film to expose the same, a shutter for momentarily opening and closing said aperture, a light source providing a light beam focused on said aperture, a plurality of type bars pivotally mounted on said frame, a transparent character outline mounted on each type bar, a plurality of finger engaging keys providing a keyboard for actuating said type bars to move said character outline into alignment with said aperture and light beam, shutter operating mechanism operable by said type bars to actuate said shutter and expose said film to provide an image of said character thereon, a shift key and a space bar on said keyboard, a rack bar on said carriage, mechanism for controlling step by step forward movements of said carriage in accordance with the widths of characters to be printed and the spaces between words, said mechanism comprising a base slidably mounted on said frame for movement parallel to the movement of said carriage, a shaft rotatably mounted on said base, a pinion fixed to said shaft and meshing with said rack bar, a first character ratchet wheel fixed to said shaft adjacent one end, a plurality of additional character ratchet wheels rotatably mounted on said shaft, the teeth on each wheel having a pitch different from the teeth on other wheels, the pitch of the teeth on each wheel corresponding to the width of a character or group of characters on said type bars, an escapement mechanism carried by each additional wheel and cooperating with the teeth on the next preceding wheel to control step by step rotation of all preceding wheels and said shaft to advance said carriage step by step in accordance with the pitch of the teeth on said next preceding wheel, means connected to each key to actuate each escapement, a justifying drum rotatably mounted on said frame, a plurality of spirally disposed ratchet teeth on said drum, the pitch of said last named teeth continuously increasing from one end of said drum to the other, a spacing escapement on said base and cooperating with the teeth on said drum to control the step by step movement of said base in accordance with the pitch of the teeth on said drum, stop means for preventing rotation of said drum, a manually operable key for releasing said stop means and linkage means operable by said space bar to actuate said spacing escapement whereby upon determining the number of character spaces and word spaces in a line of printing said drum may be rotated to provide the proper pitch of the teeth thereon in engagement with said spacing escapement to justify such line of printing.

11. A photocomposing apparatus as defined in claim 1 in which the means connecting said rock shafts and said keys includes a pair of bell crank levers for each key, means connecting one arm of each bell crank lever with the appropriate rock shaft, a V-groove in the other arm of each bell crank lever, a rocker arm for each key pivotally mounted on a shaft, a V-surface on one end of each rocker arm for engaging in said V-groove, means connecting the other end of each rocker arm with each key, spring means urging said shaft and said rocker arms into one position where said rocker arms will engage one of each pair of bell crank levers and linkage means operable by said shift key to move said shaft and rocker arms to another position where said rocker arms will engage the other one of each pair of bell crank levers whereby the proper escapements will be actuated in accordance with the upper or lower case characters being printed.

12. A photocomposing apparatus as defined in claim 1 in which the means connecting said rock shafts and said keys includes a pair of bell crank levers for each key, means connecting one arm of each bell crank lever with the apropriate rock shaft, a groove in the other arm of each bell crank lever, a rocker arm for each key pivotally mounted on a shaft, a surface on one end of each rocker arm for engaging in said groove, means connecting the other end of each rocker arm with each key, spring means urging said shaft and said rocker arms into one position where said rocker arms will engage one of each pair of bell crank levers and linkage means operable by said shift key to move said shaft and rocker arms to another position where said rocker arms will engage the other one of each pair of bell crank levers whereby the proper escapements will be actuated in accordance with the upper or lower case characters being printed.

13. A photocomposing apparatus as defined in claim 1 in which the means connecting said rock shafts and said keys includes a pair of bell crank levers for each key, means connecting one arm of each bell crank lever with the appropriate rock shaft, a groove in the other arm of each bell crank lever, a rocker arm for each key pivotally mounted on a shaft, a surface on one end of each rocker arm for engaging in said groove, means connecting the other end of each rocker arm with each key, means urging said shaft and said rocker arms into one position where said rocker arms will engage one of each pair of bell crank levers and means operable by said shift key to move said shaft and rocker arms to another position where said rocker arms will engage the other one of each pair of bell crank levers whereby the proper escapements will be actuated in accordance with the upper or lower case characters being printed.

14. A photocomposing apparatus as defined in claim 1 in which the means connecting said rock shafts and said keys includes a pair of bell crank levers for each key, means connecting one arm of each bell crank lever with the appropriate rock shaft, a rocker arm for each key pivotally mounted on a shaft, means on one end of each rocker arm for engaging said bell crank lever, means connecting the other end of each rocker arm with each key, means urging said shaft and said rocker arms into one position where said rocker arms will engage one of each pair of bell crank levers and means operable by said shift key to move said shaft and rocker arms to another position where said rocker arms will engage the other one of each pair of bell crank levers whereby the proper escapements will be actuated in accordance with the upper or lower case characters being printed.

15. A photocomposing apparatus as defined in claim 1 including back spacing mechanism comprising a lever pivotally mounted below each ratchet wheel, a pawl pivotally mounted on said lever on each side of the mounting thereof, said pawls extending upwardly on opposite sides of each ratchet wheel, spring means urging said pawls into engagement with the teeth on the associated ratchet wheel, cam means for moving said pawls out of engagement with the teeth on the associated ratchet wheel, an arm slidably and non-rotatably mounted on each rock shaft and connected to each lever for moving the same in one direction and rotating the associated ratchet wheel in a reverse direction, spring means for moving each lever in the opposite direction and a back spacing key for actuating said cam means to render said back spacing mechanism operative or inoperative.

16. A photocomposing apparatus as defined in claim 1 including back spacing mechanism comprising a lever pivotally mounted below each ratchet wheel, a pawl pivotally mounted on said lever on each side of the mounting thereof, said pawls extending upwardly on opposite sides of each ratchet wheel, means urging said pawls into en-

gagement with the teeth on the associated ratchet wheel, cam means for moving said pawls out of engagement with the teeth on the associated ratchet wheel, means mounted on each rock shaft and connected to each lever for moving the same in one direction and rotating the associated ratchet wheel in a reverse direction, means for moving each lever in the opposite direction and a back spacing key for actuating said cam means to render said back spacing mechanism operative or inoperative.

17. A photocomposing apparatus as defined in claim 1 including back spacing mechanism comprising a lever pivotally mounted below each ratchet wheel, a pawl pivotally mounted on said lever on each side of the mounting thereof, said pawls extending upwardly on opposite sides of each ratchet wheel, means urging said pawls into engagement with the teeth on the associated ratchet wheel, cam means for moving said pawls out of engagement with the teeth on the associated ratchet wheel, means mounted on each rock shaft and connected to each lever for moving the same in one direction and rotating the associated ratchet wheel in a reverse direction, and a back spacing key for actuating said cam means to render said back spacing mechanism operative or inoperative.

18. A photocomposing apparatus as defined in claim 1 including back spacing mechanism comprising a lever pivotally mounted below each ratchet wheel, a pawl pivotally mounted on said lever, said pawl extending upwardly on one side of each ratchet wheel, means urging said pawl into engagement with the teeth on the associated ratchet wheel, cam means for moving said pawl out of engagement with the teeth on the associated ratchet wheel, means mounted on each rock shaft and connected to each lever for moving the same in one direction and rotating the associated ratchet wheel in a reverse direction, and a back spacing key for actuating said cam means to render said back spacing mechanism operative or inoperative.

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