United States Patent

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[72] Inventor **Ernest Everet Minett**
Rochester, N.Y.

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[73] Assignee **Xerox Corporation**
Rochester, N.Y.

[54] **APPARATUS FOR JUSTIFYING A REPRODUCED LINE OF CHARACTERS**
9 Claims, 2 Drawing Figs.

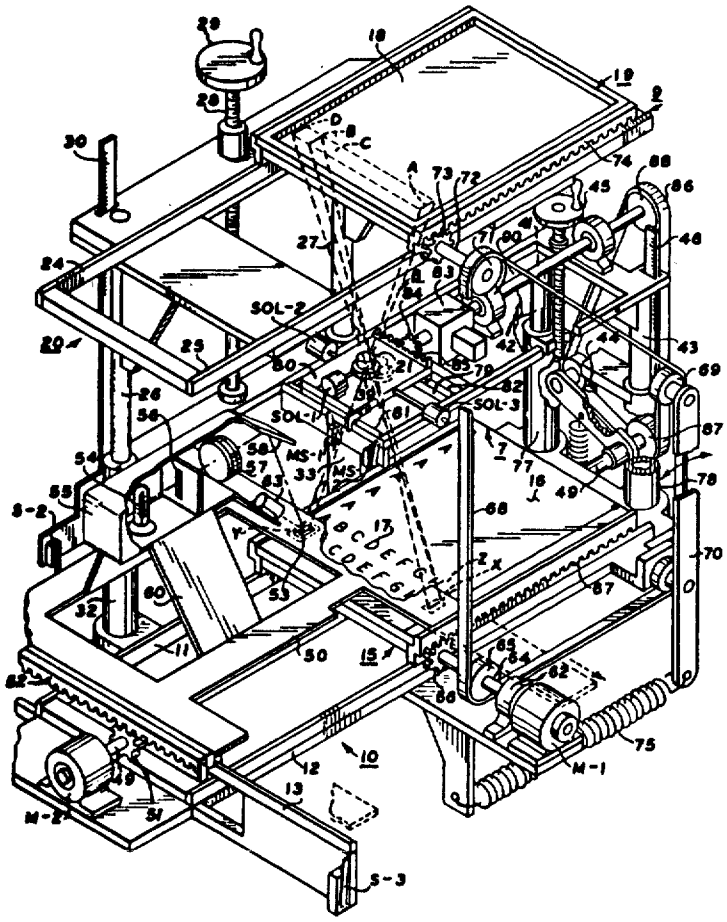
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[50] Field of Search ..... 95/4.5 J; 355/52, 40, 41

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Primary Examiner—Samuel S. Matthews
Assistant Examiner—Daniel J. Clement
Attorneys—Paul M. Enlow, Donald F Daley, James J. Ralabate, Norman E. Schrader, Ronald Zibelli and August E. Roehrig, Jr.

ABSTRACT: Apparatus for justifying a line of printed matter including a planar support for an original document to be justified positioned in an optical path relative to a planar support for a sensitized recording member such that an original document is scanned to project a justified image onto the recording medium. The justifying apparatus includes an asymmetric lens supported by a lens carriage positioned intermediate the original document support and the recording member support and movable at a synchronous speed related to a scanning mechanism to expand or contract the graphic data for justifying the image onto the recording medium.



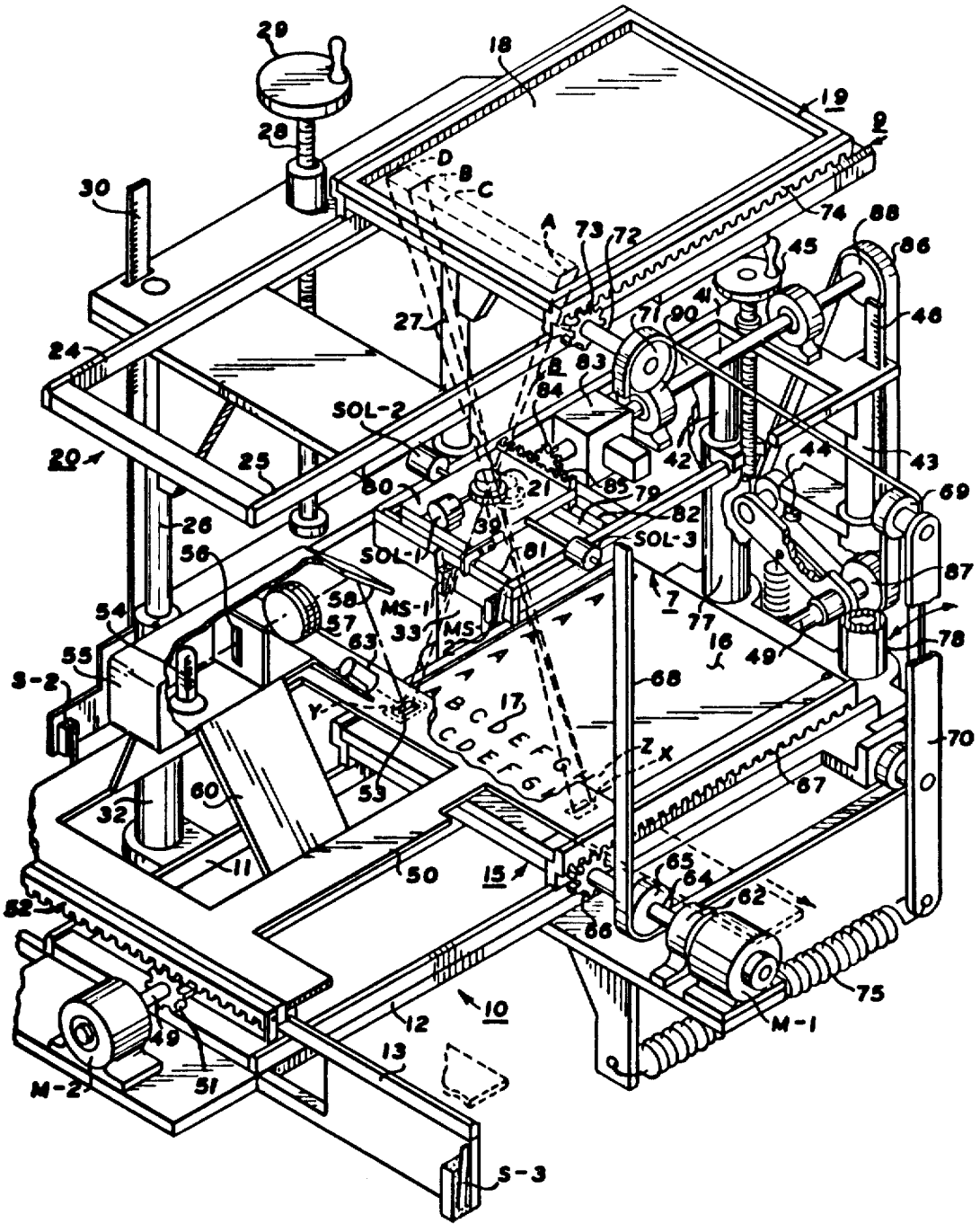


FIG. 1

INVENTOR.
ERNEST E. MINETT
BY
ATTORNEY

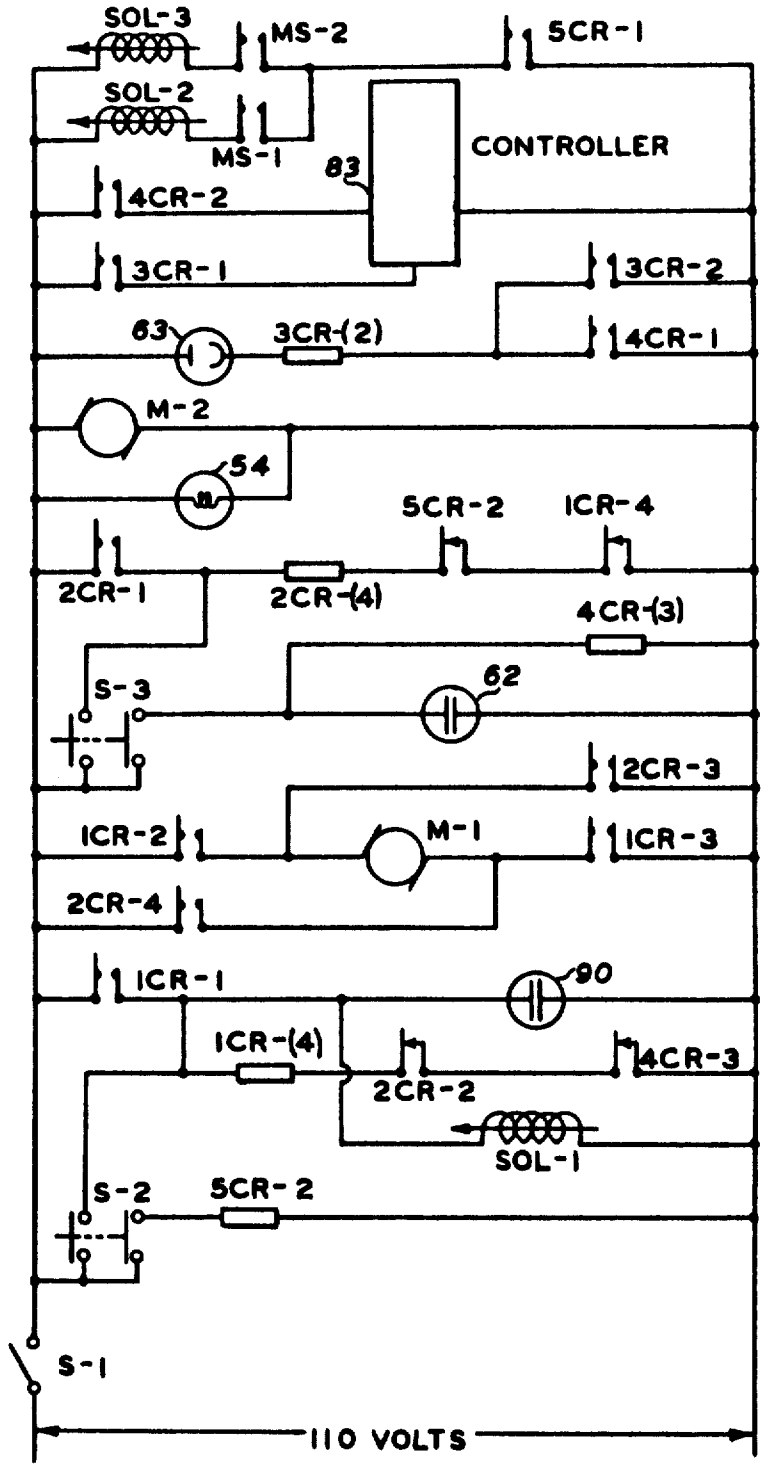

SOL-3
MS-2
5CR-1
SOL-2
MS-1
CONTROLLER
83
4CR-2
3CR-1
3CR-2
63
3CR-(2)
4CR-1
M-2
54
5CR-2
ICR-4
2CR-1
2CR-(4)
4CR-(3)
S-3
62
2CR-3
ICR-2
M-1
ICR-3
2CR-4
ICR-1
90
ICR-(4)
4CR-3
2CR-2
SOL-1
S-2
5CR-2
S-1
110 VOLTS

FIG. 2

APPARATUS FOR JUSTIFYING A REPRODUCED LINE OF CHARACTERS

RELATED APPLICATIONS

This application is a divisional of Applicant's prior copending application Ser. No. 468,698 filed July 1, 1965.

BACKGROUND OF THE INVENTION

This invention relates to the graphic arts and particularly to method and apparatus for justifying a line of characters in the reproduction of previously unjustified original copy.

Many different methods of justifying lines of characters are known in the art and are incorporated in such devices as typewriters, linotype machines, and the like. It is usual in such devices to compress or expand a line of characters in the initial reproduction of an original document to dimensionally control character size in one direction in order to obtain line justification, or to obtain an analogous result by means of variation of intercharacter or interword spacing. Where justification is to be effected from original unjustified copy, it is usual in accordance with prior art techniques to employ an anamorphic lens or the like which optically distorts the original in the direction of line length in order to increase or decrease the length in accordance with the justification to be obtained.

SUMMARY OF THE INVENTION

Now in accordance with the instant invention, there is provided novel method and apparatus whereby a reproduction line-by-line justification of previously prepared unjustified copy can be effected with greater simplicity than heretofore and without employing an anamorphic lens. By means hereof, stretching or compression of each line of copy as conformed to a standard length is accomplished by purely mechanical operations of components through an asymmetric lens without causing magnification of the image characters in a vertical direction. These results are obtained while an original copy and sensitized recording member are supported optically separated and fixed throughout the operation requiring only the motion of lightweight mechanical parts and motions of small magnitude. Inherently fast operation is provided and features are afforded which are important in the economics and maintainability of a justifying device.

Accordingly, it is an object of the invention to provide novel method and apparatus for justifying a line of characters in the reproduction of previously prepared unjustified copy.

It is a further object of the invention to provide apparatus for justifying a line of characters in the reproduction thereof by principally mechanical means and without the necessity of an anamorphic lens.

It is a still further object of the invention to provide apparatus for line-by-line justifying of characters in the reproduction thereof in a manner able to control the stretching or compression of each line length by principally mechanical means and without inherent vertical magnification of the image characters.

These and other objects are obtained by means of the apparatus of the invention in which a line of previously prepared unjustified copy is first photoelectrically scanned to ascertain the line length with regard to a reference standard to be maintained. The line is then oppositely scanned during a projection cycle that includes a conventional distortion-free type projection lens that is controllably moved from the determination of said sensing means and concomitantly with the image projection onto a sensitized reproduction surface.

DESCRIPTION OF THE DRAWINGS

The advantages of the present invention will become apparent upon consideration of the following detailed disclosure of an embodiment to be described in conjunction with the accompanying drawings in which:

FIG. 1 is an isometric view of an apparatus embodying the principles of the invention; and

FIG. 2 is a schematic electrical diagram for operation of the device of FIG. 1.

DESCRIPTION OF PREFERRED EMBODIMENT

Referring now to FIG. 1 the apparatus includes components arranged optically superpositioned and comprising a copy station 7, optical station 8, and recording station 9 respectively defining generally the object, focal and image planes.

The copy station includes the components for scanning and supporting an original unjustified copy and is comprised of a support frame 10 having side rails 11 and 12 and front rail 13 each having bevel-formed top edges serving as guideways as will be described. Supported on the scanning side rails for movement thereon is a rectangular copy holder carriage 15 including a recess in the top surface thereof to receive and retain a copy to be reproduced 16 having a plurality of linearly arranged image characters 17.

The carriage is adapted to be advanced incrementally on its side rails a distance corresponding to the line-to-line spacing of the image characters on copy sheet 16. When an advance is required, as will be understood it is effected by means of a continuously operative motor M-1 which when connected through a partial revolution magnetic clutch 62 engages drive shaft 64. Secured to the drive shaft on the output end of the clutch are timing pulley 65 and pinion 66, the former of which engages a timing belt 68 for moving the recording station elements in unison therewith while the latter engages rack 67 of the copyholder carriage.

Arranged to overlie a line of image characters and to effect a traverse scanning thereof is a T-shaped scanning bar 50 which completely conceals the image characters 17 except for a thin rectangular aperture 53 encompassing the vertical image height. As the scan bar is moved, the aperture traverses between a position represented by line "Y" corresponding arbitrarily to the left-hand image margin of copy sheet 16, and a position represented by a line "X" corresponding to about the right edge extremity of the copy sheet. As can be appreciated, a line of image characters 17 will be contained within the linear spacing extending between X and Y.

Reversible transverse movement of the scan bar over the top edge of rail 13 is effected by means of motor M-2 coupled to elongated shaft 49 on which is secured a pinion 51 meshing with rack 52 on the underside of the scan bar. The bar is adapted to be moved in the direction shown by the arrow from a position shown solid to that shown dashed. At opposite ends of travel are switches S-2 and S-3 which are activated as the bar arrives in each of the respective positions.

Illumination of the copy sheet below aperture 53 is provided from a lamp 54 in a housing 55 secured via support plate 60 to the scan bar in order to move therewith. Radiation from the lamp is caused to pass through a masked slit 56 to a condensing lens 57 from which it is focused onto a mirror surface 58 and then reflected rectangularly downward through aperture 53. Extending secured on the underside of the lamp housing in a reflecting relation to the copy surface below aperture 53, is a photoelectric detector 63 which is operative in ascertaining line length as will be described.

The optical section 8 includes a rectangular frame support 41 supported on vertical end-guide posts 42 and 43 extending up from sleeves 77 and 78 respectively, each in turn, secured to lower frame 10. At the forward end of the frame is an opening 79 over which there is mounted a controllably movable saddle 80 containing an asymmetric lens 21 in a mount above a shutter 39 operative under control of solenoid SOL-1. The saddle includes guideways adapted for riding on bevels 81 and 82 linearly in either direction as to move the lens from optical center determined as a function whether image justification is to represent a compression or expansion relative to the original as will be understood. Movement of the saddle, when required, is at a controlled rate of speed correlated to the

degree of justification to be effected and is produced from the output of a commercially available presettable speed and directional controller **83**. Input to the controller **83** is derived via timing belt **86** being driven by pulley **87** on the extended end of motor shaft **49**. The belt in turn drives pulley **88** on shaft **89** connecting to a magnetic clutch **90** connected when energized to the input side of the controller. The controller output is connected via pinion **84** engaging a rack **85** forming part of the rearward end of the saddle **80**. By this means, lens movement is maintained completely synchronized with the movement of the scanning bar **50**.

Following each projection cycle, lens **21** is returned to its optically centered position by means of piston solenoids SOL–**2** and SOL–**3** connected to opposite sides of the saddle and actuated at the appropriate point in the cycle by means of microswitches MS–**1** and MS–**2** respectively. The slightest movement of the saddle in either direction from optical center places the microswitches in their activated position.

The recording station **9** likewise includes a rectangular frame **20** including side rails **24** and **25** and mounted via vertical guide posts **26** and **27** extending up from sleeves **32** and **33** respectively secured to lower frame **10**. Supported on the latter side rails is a holder **19** having a centrally open portion therein over which to receive and retain a sheet of light sensitive recording material **18** such as photographic film, xerographic plate or the like. Both copyholder **15** and film holder **19** are optically aligned substantially coextensive in parallel planes and adapted to be moved in unison codirectionally and equidistantly. With each incremental advance of copyholder **15** in preparation for projecting a justified image from a line of original unjustified characters **17**, film holder **19** is simultaneously advanced equidistantly by means of timing belt **68** engaging timing pulley **71** secured to a common shaft **72** with pinion **73** meshing with film holder rack **74**. Idler pulley **69** in lever **70** is under continuous tension by means of spring **75** to maintain timing belt **68** slack-free at all times.

Image reproduction generally is one-to-one but can comprise any magnification ratio desired. In order to optically adjust for any ratio, the plane of frame **20** is positionable by means of vertical lead screw **28** having a hand wheel **29** thereon which permits the frame to be raised or lowered as required. The desired position of the frame can be set in accordance with the indications contained on vertical calibration plate **30**. Likewise, optical support frame **41** is positionally secured via vertical lead screw **44** having a hand wheel **45** whereby it too can be positioned in accordance with the calibrations contained on vertical calibration plate **46**.

Having described the operable components hereof, the operation of the apparatus in accordance with the objectives of the invention will now be described with reference also to FIG. **2**. Operation is initiated with scanning bar **50** in the rightmost position (shown dotted) and slit aperture **53** overlying the hypothetical position "X" from which line length of the characters is determined relative to a margin line "Z" to be maintained. That is, character lines terminating at "Z" are to be unchanged while termination between "X" and "Z" are to be compressed and between "Y" and "Z" are to be expanded. It is the intention therefore, that margins "A" and "B" are to be maintained on film **18** such that images which would otherwise fall at "C" are to be expanded while those falling at "D" are to be compressed as to coincide with "B."

With the scanning bar in this position switch S–**3** is actuated energizing relay **2**–CR to energize motor M–**2**. As the scan bar traverses leftwardly, this illuminated copy below aperture **53** is immediately reflected into photosensor **63** emitting a signal sufficient to energize relay **3**CR through the contacts of relay **4**CR closing contact **3**–CR**1**. For so long as it remains energized, the latter contact continues to preset the operating conditions for controller **83** incrementally from a maximum transport speed in an image compressing direction past a neutral inoperative position represented by margin position "Z" to a maximum transport speed in an expanding direction. On detecting the first character image **17** the reduced reflection intensity to the photocell reduces the emitted signal therefrom to deenergize relay **3**–CR which then fixes the setting of the controller as it will be operative in the projection cycle. The scanning bar continues its leftward movement until striking switch S–**2**. This energizes relay **5**–CR which through its contact permits MS–**1** or MS–**2** to restore lens **21** to an optically centered position while also energizing relay **1**–CR which through its contacts energizes shutter solenoid SOL–**1**, clutch **90** and reverses the direction of scan motor M–**2**.

The projection cycle is then initiated with the shutter open and the line of image characters contained on copy sheet **16** are scanningly projected onto film **18**. By means of the preset operating position of controller **83**, the operating direction and movement thereof, if any, shifts the lens axis rightwardly for compression and leftwardly for expansion of the original image at a rate correlated to the degree of justification to be effected. Where justification for the particular line being reproduced is unnecessary, controller **83** remains set at its neutral inoperative position.

The scanning bar continues its movement to its rightmost position until again striking switch S–**3**. This again energizes relay **2**–CR which is effective to energize clutch **62** whereby to advance the copy support the equivalent of one line below the scanning bar with the film holder moving an identical amount. At the same time, contact **4**–CR**2**, connected to controller **83** resets the controller to the start position in preparation for a resetting in a subsequent length determination scan cycle. Suitable time delays are included to operation of the sequential functions. For lines not to be justified, such as the salutation on correspondence copy, clutch **90** remains inoperative.

By the above description, there is disclosed novel apparatus for effecting monodimensional justification of previously unjustified copy reproduced onto a recording member. The apparatus is simple to construct and operate and functions principally with mechanical motions and without the use of an anamorphic lens as has been customary in the prior art. Since many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the drawings and specification shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. Justifying apparatus for producing a copy having uniform length lines of characters from an original document having character lines of an unequal length comprising:

a lens supported for planar movement between a document holder adapted to support an unjustified original document containing unequal length lines of characters and a copy holder adapted to support a copy material upon which a justified copy having uniform length lines of characters is to be produced,

cyclically operable scan means operative in a prescan portion of a cycle to traverse said original document holder for determining the variation of an unjustified line of characters from a predetermined standard line length to transmit a control signal indicative of the degree of variation determined, and operative in a projection portion of the cycle to transverse said original document holder for projecting an unjustified line of characters through said lens to said copy holder as a justified line of characters,

control means for receiving said control signal operatively connected to said lens to effect planar movement thereof in synchronism with the traversal of said scan means during the projection portion of said cycle in a direction and at a speed relative thereto as determined by said control signal, and

means for varying the conjugate distances of said holders relative to said lens for varying the magnification ratio by which the image characters are to be reproduced.

2. Justification apparatus for producing a copy having uniform length lines of characters from an original document having character lines of an unequal length comprising,

a lens supported for planar movement between a document holder adapted to support an unjustified original document containing unequal length lines of characters and a copy holder adapted to support a copy material upon which a justified copy having uniform length lines of characters is to be produced,

cyclically operable scan means operative in a prescan portion of a cycle to traverse said original document holder for determining the variation of an unjustified line of characters from a predetermined standard line length to transmit a control signal indicative of the degree of variation determined, and operative in a projection portion of the cycle to transverse said original document holder for projecting an unjustified line of characters through said lens to said copy holder as a justified character line, said scan means including an elongated member overlying said document holder and having an aperture therein for exposing restricted portions of said original unjustified document supportable on said document holder and a photosensor and illumination source, said illumination source being positioned to direct a beam of light through said aperture into said photosensor for varying an output control signal emitted from said photosensor in accordance with the intensity of the light beam directed there into, thereby determining the variation of an unjustified line of characters from a predetermined standard line length as indicated by said varying output control signal emitted from said photosensor, and

control means for receiving said varying output control signal and operatively connected to said lens to effect planar movement thereof in synchronism with the traversal of said scan means during the projection portion of said cycle in a direction and at a speed relative thereto as determined by said varying output control signal.

3. The apparatus of claim 2 wherein the output signal from said photosensor is coupled to said control means for presetting the movement of said lens during the prescan portion of said scan means cycle and effecting said lens movement during the projection portion of said scan means cycle.

4. The apparatus of claim 2 wherein said illumination source directs said light beam through said aperture to project a character of an original unjustified document supportable on said document holder through said lens onto said copy holder during the projection portion of said scan means cycle.

5. The apparatus of claim 4 wherein said lens includes a shutter operable to intercept said light beam to prevent a character from being projected to said copy holder during the prescan portion of said scan means cycle and movable out from interference with said light beam to allow a character to be projected to said copy holder during the projection portion of said scan means cycle.

6. Justification apparatus for producing a copy having uniform length lines of characters from an original document having character lines of unequal length comprising;

a document holder for supporting an unjustified original document containing character lines of unequal length,

a copy holder for supporting a copy material upon which a justified copy having uniform length lines of characters is to be produced,

line scanning means for scanning a line of the unjustified original document and for generating a control signal representing the length of the line so scanned and for transmitting said control signal to a control means,

a lens supported in a plane between said document holder and said copy holder for scanningly projecting a line of characters of said original document through a slit aperture onto said copy material and normally positioned in said plane for reproducing an image of a line of original characters of predetermined length,

slit aperture means movable with said line scanning means and movable with said lens, for scanning said line of the unjustified original document in synchronism with said line scanning means during the line scanning operation of said line scanning means and for rescanning the same line of the unjustified original document in synchronism with said lens during the projection operation of said lens, and

control means for moving said lens in its plane at a controlled rate of speed correlated to the degree of justification and parallel with the line of characters to be copied, in one direction for compressing the length of the image of the original line of characters when the control signal indicates the line of original characters is longer than said predetermined length and for moving said lens in the opposite direction for increasing the length of the image of the original line of characters when the said control signal indicates the line of original characters is shorter than said predetermined length for producing a copy of an original document having lines of characters of uniform length.

7. Justification apparatus as in claim 6 wherein

said line scanning means scans a line of characters of said original document with said control means holding said lens in its normal position,

said lens images the line of characters during movement of said lens by said control means and said control means further includes,

means for returning said lens to its normal position in its said plane after having imaged said line of characters on said copy.

8. Justification apparatus as in claim 7 and said lens further includes,

shutter means for opening said lens only after receipt of said control signal by said control means and for closing said lens prior to return of said lens to its said normal position.

9. Justification apparatus as in claim 6 in which

said document holder and said copy holder are supported in optically aligned position in parallel planes and said apparatus further includes,

means cyclically operated for incrementally advancing said document holder and said copy holder in unison codirectionally for producing a copy of each sequentially positioned line of characters of the original document.