United States Patent

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[54] **TURRET FONT PHOTOCOMPOSING MACHINE**
2 Claims, 9 Drawing Figs.

[52] **U.S. Cl.** 95/4.5, 95/45
[51] **Int. Cl.** B41b 15/34
[50] **Field of Search** 95/4.5, 45

[56] **References Cited**

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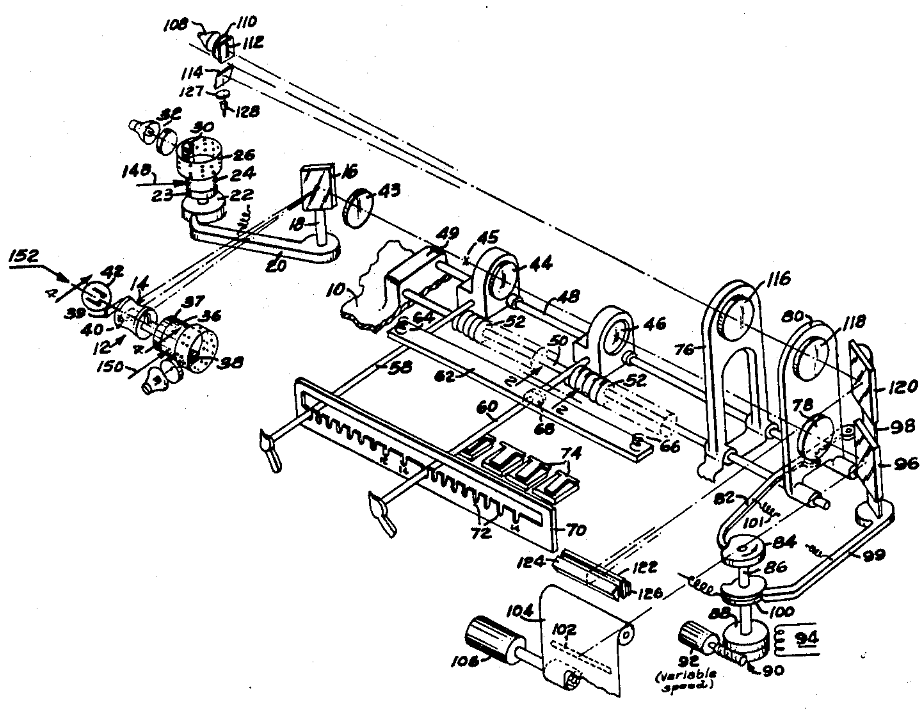
ABSTRACT: A photocomposing apparatus employing a variable-magnification lens system for projecting characters from a character font onto a record film at a variety of effective point-sizes, and in which positive and readily settable detent elements are provided to position the lens elements at the various precise positions required for the desired range of point sizes, by simple manual operations carried out in a few seconds for each such change.



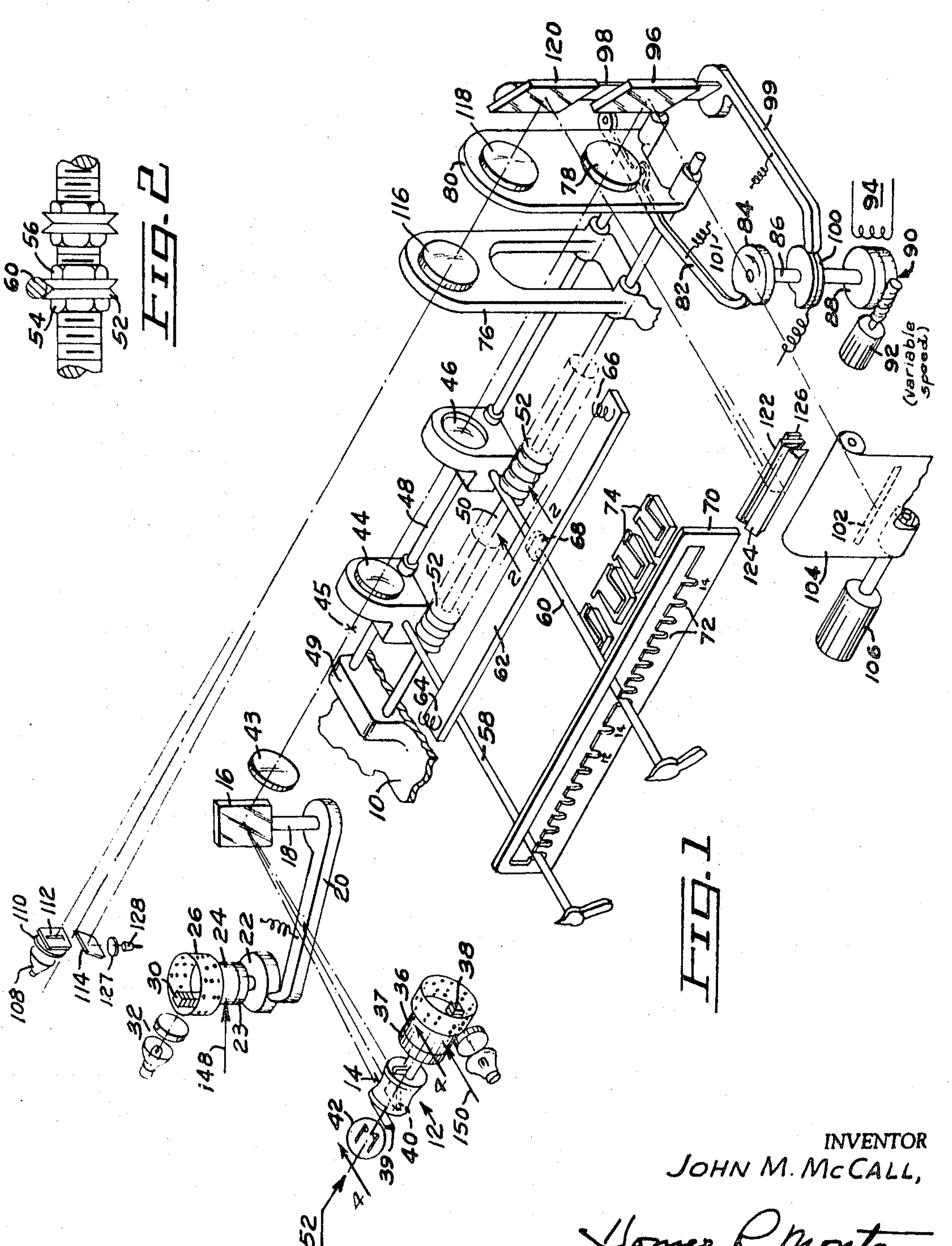


Fig. 2

Fig. 1

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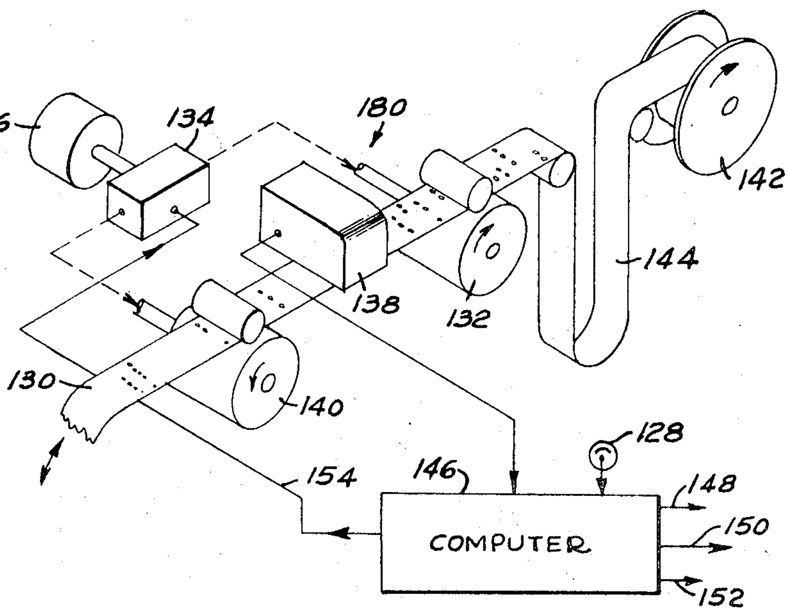

Fig. 3

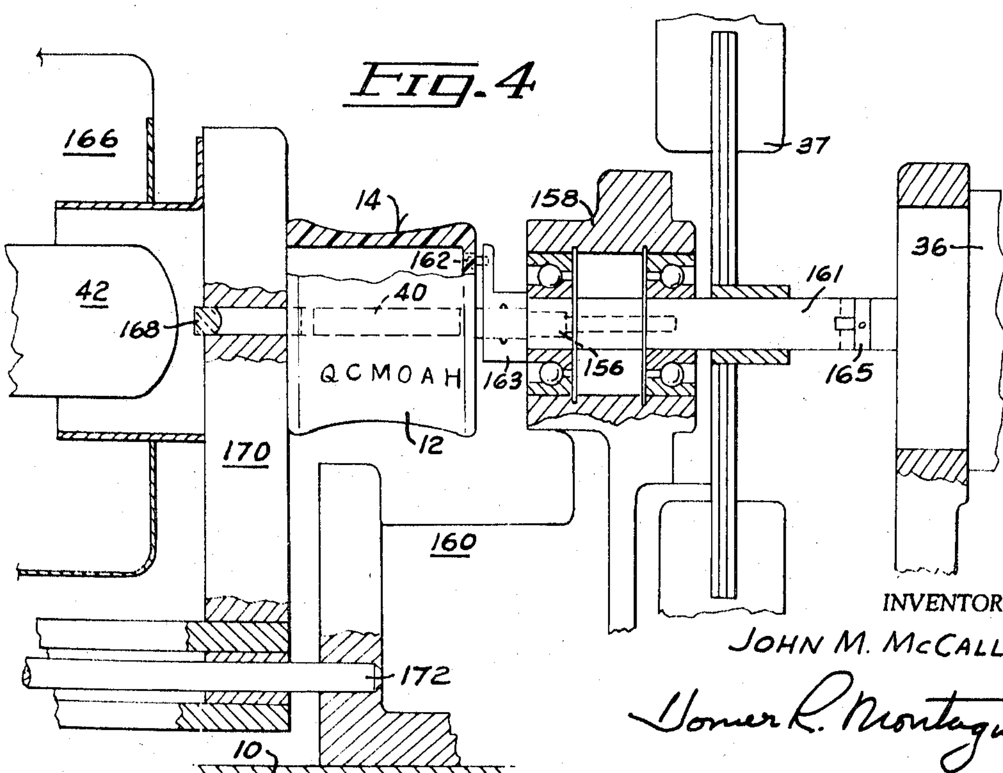

Fig. 4

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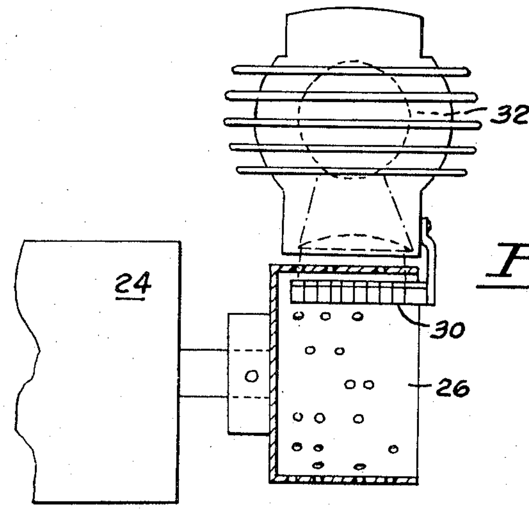


Fig. 5

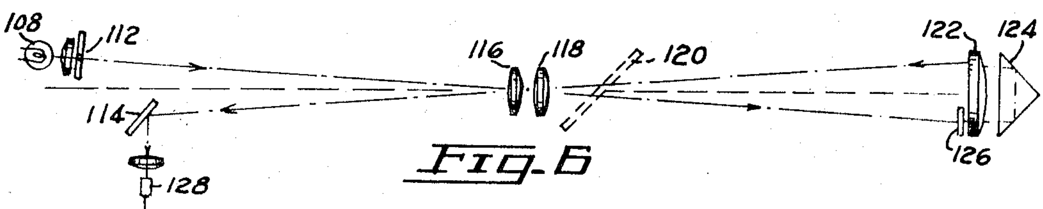


Fig. 6

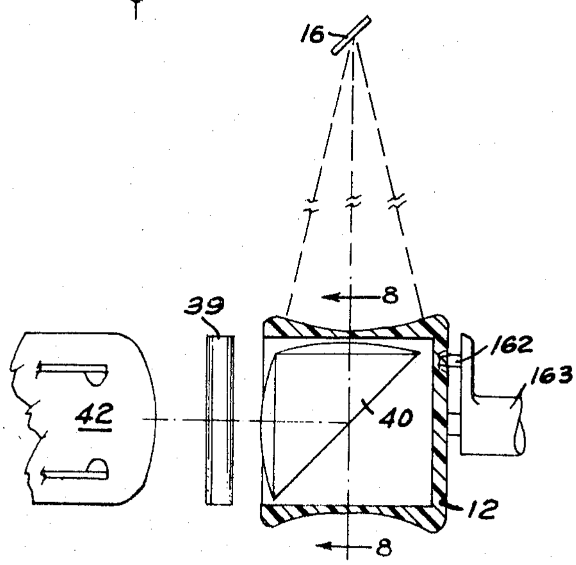
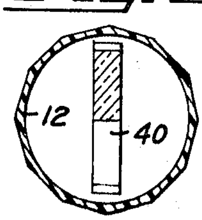


Fig. 7

Fig. 8



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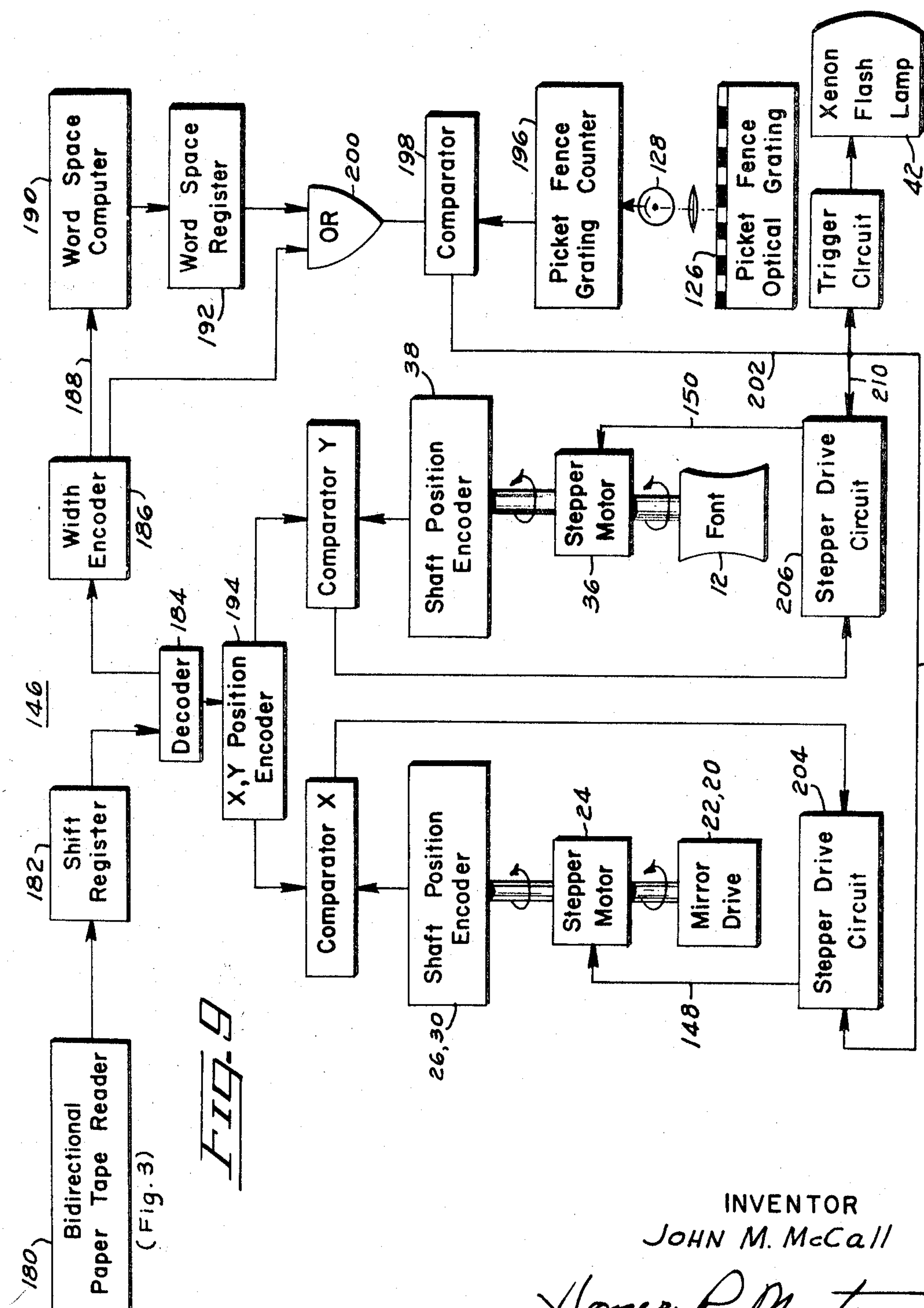

Fig. 9

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TURRET FONT PHOTOCOMPOSING MACHINE

This is a division of Ser. No. 519,906, filed Jan. 11, 1966 and allowed Mar. 18, 1968, now U.S. Pat. No. 3,434,402.

This invention pertains to photocomposing equipment, and has for its principal object the provision of a photocomposing machine which can be made very compact, will provide an adequate font size for a large portion of the requirements for commercial typesetting, will operate at a reasonably high speed, will permit rapid changing of the entire font to accommodate varying type face requirements, and will include provision for the change of magnification, by optical means, to vary the effective point size of the type face images laid down upon photographically sensitive record material.

Another object of the invention is to provide such a machine with a novel form of font element, specifically one in the form of a small, hollow drum whose outer cylinder surface is concave or dished inwardly, and which carries the type face images on its outer face in rows and columns which are respectively lengthwise of the axial direction plane of the drum or spool, and in planes perpendicular to the drum axis. The concavity of the drum face provides for equalization of the distance to the face of a rotating mirror that is employed to select as amongst all the characters in a given ringlike column, and rotation of the drum permits selection of the particular axial row desired.

The outer, dished surface of the drum preferably is composed of a series of strip surfaces which are flat in the circumferential direction, and the cross section in a plane perpendicular to the drum axis is a polygon having as many sides as there are character rows on the drum. This ensures that the character images are not distorted by reason of the usual circumferential curvature of a cylindrical surface, and the radius of the dishing curvature is several times the diameter of the drum, so that only a tolerable alteration of character shape (which can be fully eliminated, if desired, by predistortion of an opposite sense) results.

The small size and low mass of the hollow drum font satisfies a further object of the invention, which is to minimize its inertia and hence minimize the time required for the drum to be positioned, in the rotary direction, by an intermittent mechanical selection drive, to the end that selection of the needed character row can be accomplished in something like the same time that is required for the external selecting mirror to position itself at a chosen character image position in the axial-of-the-drum direction; and such that both these selection operations can be repeated at a speed commensurate with the requirements of commercial type composing.

An additional object of the invention is to free the equipment from the limitations of various known photocomposing schemes with respect to the need for an extremely high-speed flash of exposing light, the requirement being due to attempts to make the exposure while the font character, or the recording material, is actually in continuous motion. The present invention utilizes a short flash of light for each exposure, to obtain a high rate of repetition of character selections, but all of the fast-moving mechanical parts are at rest during such exposure, so that it can be comparatively long, of the order of milliseconds.

Still another object of the invention is to provide apparatus of the above general type in which the final optical element in the train which images the character font images on the photographic film or paper is a cyclically-swinging mirror or equivalent which sweeps across the exposure line area of the output record strip at a constant rate, to effect the sequence of placement of chosen characters with the desired spacing, including the spacing devoted to the width of the chosen character as well as the variable word-spacing utilized to effect line-width justification. As this deflector sweeps, and as chosen characters from the font are placed at the input end of the optical system, the exposure lamp, effectively inside the font drum, is flashed at the proper instants both to make the exposure and to make it at the proper instant for correct character placement. In order that the instants of flashing may be precisely related to the position of the rotating or sweeping deflector, a secondary optical system continuously monitors the position of the sweeping deflector with reference to a line grating positioned near the image recording (paper or film) end of the machine.

The invention also includes an unusually simple and low-cost optical system to permit selective magnification or point-size control during the use of any given font element or font drum. This system utilizes a pair of selectively positionable projection lenses, in an essentially varifocal or zoom configuration, and devices to permit the operator to position them with precision at the necessary locations to provide properly focused type face images of specified point-size. The same optical system includes provisions for compensating for the slight variation in recording film distance (from the output mirror or deflector) as the beam sweeps along each composed line. Integrally related optical components provide for the maintenance of focus with respect to the grating-monitoring optics. Finally, the machine includes automatic provision for varying the line-composing sweep rate in accordance with the point-size selected by the setting of the optical system, to provide the greater line-composing time required when smaller point sizes are being set. In this connection, it will be recalled that the basic limitation on composing speed in this system is the rate at which the font drum can be repositioned for each successive character, so that a line of a given length requires more character selections per line and hence a longer line-composing interval.

Another object of the invention is to provide a machine of the above type which is especially adapted to the photo composition of type face images under the external selection control of a conventional punched paper tape record, or equivalent, such as the punched control tape of known signal-controlled linecasting machines such as the "Teletypesetter" machine. Such tapes carry a record, in standard code, of the successive character selections, the word spaces, and various functional operations such as shift and unshift (or case selection), upper and lower rail selection, rubout (delete), end-of-line code, and so on. The present invention utilizes, when under the control of such a tape record, a special tape reader arrangement which first scans a one-line length segment of the tape to derive the information as to the aggregate of widths of all of the specified characters and word spaces for that line, and delivers this information to a computer which furnishes the necessary correlation by which the exposure lamp will be flashed when each character is in its proper projected position relative to the recording film or paper, to provide a justified line. Once this information has been derived from the tape, the latter is rapidly reversed to the starting position of its line record during the computing operation, and is read a second time to control the successive selections of the drum font and selecting mirror positions to effect actual character selection and projection.

The invention will now be described in detail, by way of illustration and explanation (and not for purposes of limitation), in connection with one preferred embodiment, reference being made to the accompanying drawings, in which:

FIG. 1 is a diagrammatic perspective view of the main physical components of the preferred embodiment of the apparatus.

FIG. 2 is an enlarged, fragmentary sectional view taken on line 2–2 of FIG. 1.

FIG. 3 is a diagrammatic perspective view of a tape reader arrangement for the apparatus.

FIG. 4 is an enlarged sectional view (compared to the scale of FIG. 1) taken substantially along the line 4–4 of FIG. 1 but illustrating in more detail the mounting of the font drum and its illuminating system.

FIG. 5 is a detailed, partly sectional view illustrating the construction of one of the position-sensing encoders, specifically the one that is associated with the selecting mirror drive.

FIG. 6 is a plan view of the optical system employed for counting grating spaces to control the location of exposure of each font character on the photographic recording film or paper, the schematic being straightened out to simplify understanding thereof.

FIG. 7 is a fragmentary horizontal sectional view of the font drum and related parts, taken in the direction looking down on FIG. 4.

FIG. 8 is a sectional view taken along line 8—8 of FIG. 7.

FIG. 9 is a simplified block diagram showing major components of the computing and control system typically employed with the invention, and their relation to the parts illustrated in the foregoing FIGS.

Referring to FIG. 1 of the drawings, the major physical and optical components of the photocomposing machine are shown as mounted upon a horizontal support 10 (of desk top size or smaller), with a conventional casing or cover removed for purposes of this illustration. The character font unit is indicated at numeral 12, its dished-drum or hour-glass conformation being indicated at 14 and providing a character row on each of its flat facets, the facets forming each arcuate row being centered at a point on the surface of the first-surface reflector 16 which point also lies in the vertical rotational axis of that reflector, indicated by the axis 18. A lever arm 20 secured to the axle is spring-urged against a cam 22 whose position is established by a high speed stepper motor 24, its shaft being detented as by an electromagnetic detent mechanism 23 so that the motor position establishes which particular character from the selected axial row is positioned along the input axis of the following projection optical system. The stepper motor control includes a coded-spot digital transducer track on the rim of encoder drum 26, which allows the instantaneous stepper position to be sensed by a suitable array of photocells, or the like, indicated as a unit by numeral 30 within the encoder drum 26, one axial row of code holes being illuminated by a lamp and condenser lens system 32. The details of the encoder drum optics are shown in FIG. 5 of the drawings.

The font drum 12 has an integral stub axle or quill which snaps removably into a socket in a shaft driven by an identical stepper motor 36, whose position is also detented as at 37 and is readable by a digital coded-spot encoder drum transducer to identify the angular setting of the font drum in terms of the energization of the cell array represented at 38. The control systems of both stepper motors are related so as to provide in effect an X-Y coordinate selecting system for displaying individual font characters in succession to the projection optics that will be described below.

As also indicated in FIG. 1, but in more detail in FIGS. 7 and 8, the font drum is hollow, with the far end open to receive a relatively think, flat right-angle prism 40 that directs a concentrated, flat beam of light upon the rear surface of each column of font characters, from a concentrated, high-speed xenon flash lamp 42 and the cylindrical condenser lens 39. The end faces of the prism are curved to act as lenses to provide, in combination with the condenser lens, proper spread and concentration characteristics for the font-column illumination, as well as to neutralize the curvature of the transparent wall of the font drum insofar as it affects font illumination.

The image of each selected font character proceeds from selecting reflector 16 through a fixed objective lens 43 which forms a real image of the selected font character approximately at point 45, this image forming the real object of a system comprising the pair of lenses 44, 46 which together form a variable-magnification system, being slidably mounted on a bearing rod 48 secured by bracket 49 to the underlying support 10. A second rod, 50, mounted parallel to rod 48, carries an assembly of V-grooved wheels 52 which are individually located along rod 50 by means of nuts 54, 56 (for example) shown in FIG. 2 as threaded upon a threaded portion of rod 50. The precise position of each V-groove wheel establishes one precise position of one of the carriages of lenses 44 and 46, corresponding to a particular point-size change magnification ratio of the lens pair; this positioning results from the fact that each lens carriage has a lateral rod 58, 60 which extends in contact with the grooved face of one wheel, thence beneath a locking bar 62 pressed downwardly by springs 64, 66 from a blocked upper limit position established by fixed stops (not shown). Where it passes beneath bar 62, each rod 58 and 60 carries a cam such as 68, and both rods extend forwardly to pass through a notched coarse-selection locating plate 70 having an upper longitudinal slot from which depend individual vertical notches 72 corresponding to the respective lens positions for a range of type point sizes obtainable from a particular font drum 12. Thus, and from a typical font drum size of approximately 1½ inch diameter and 1½ inch length, with 24 equispaced facets and 9 characters along each facet, it is entirely feasible to provide a full range of exposure-plane type sizes such as 5-½6, 7, 8, 9, 10, 12 and 14 points. ½,

A locking position of each rod 58 and 60, in the rotary sense, is provided by the cams 68, which urge the rods downward when they are turned to raise the bar 62 against its upward stops. To change point size, both rods are rotated slightly to lower bar 62 from its upper limited position, allowing the rods to be raised out of the notches 72 and slid along the upper slot in plate 70 to a new position, then lowered (springs 64 and 66 urge them down) into the new notch 72, and again rotated to lock them in place. As the rods were raised, they left the V-grooves of the respective precise-locating wheels 52, and when again locked in place, they fall into a different wheel at the precise proper position for the corresponding lens. There is sufficient flexure in each rod 58 and 60 to ensure that the precision provided by the close positioning of the V-grooved wheels will not be overcome by rough handling of the control knobs on the rods, and approximate alignment of the point-size scale marked on plate 70 is adequate. The new positions of the lenses 44 and 46 provide correct focus at the image plane of the system, with the specified and selected magnification, and without requiring displacement of either the film plane or the font drum location.

One of the rods, such as rod 60, is arranged to operate a selected one of several microswitches 74 mounted on the basic support, these switches causing appropriate change in the sweeping speed of the character-placement motor in a manner to be described.

The beam of light from varifocal lens system 44 and 46 proceeds through a space between the legs of a fixed-position lens mounted 76 (whose lower portion also forms the support bracket for bearing rods 48 and 50), and thence through a projection lens 78 mounted in a support frame 80 slidable through a limited range along the bearing rods, under control of a lever arm 82 pivoted at one end on the basic support 10 and having its other end spring-urged against a cam 84 on a shaft 86 connected by a magnetic clutch 88 to gearing 90 driven by the sweep-control motor 92. The operating coil for the clutch is indicated at 94.

The character-beam leaving lens 78 is reflected at a first-surface reflector 96 whose face lies in the vertical plane of rotation of a shaft 98 journaled in the basic support of the apparatus, this shaft being secured to a lever 99 which is spring-urged against a sweep cam 100 also on the shaft 86 that is controlled by clutch 88. So long as the clutch is engaged, the cam 100 causes a relatively slow traverse of the output beam from mirror 96 along the suitably masked-off line composition area 102 on the recording film or paper 104, arranged for line-feed, between composed line exposures, by a conventional takeup motor 106. The slow-sweep direction along the composed line area, as viewed in FIG. 1, will be from left to right, since we are viewing through the rear surface of the recording film. At the end of each relatively slow line-sweep, clutch 88 is deenergized, allowing cam 100 to return in response to the force of spring 101, and causing the beam direction to return to the beginning of the next line, and the film is line-fed before composition of the next line commences.

In order to maintain the character beam arriving at the record film in proper focus despite the fact that the distance from the axis of the reflector **96** to the record film is slightly greater when the beam is near either edge of the line, the cam **84** is given a heart-shape profile of such configuration as to move the final lens **78** just sufficient, during each sweep, as to compensate for the slight change in imaging distance. This provision eliminates the need for providing means for curving the record film in its transverse direction, as would otherwise be required to prevent serious defocusing either at the film center or both edges.

From what has been said above, it is obvious that the correct positioning of each successive character, along the composing line area **102**, requires that the flash lamp **42** be fired after the desired character has been placed on the optical projection axis, by motors **24** and **36**, and at precisely the correct instant during the sweeping progress of the beam direction leaving mirror **96**. Since the lamp will be flashed only intermittently, as each selected character image arrives at the correct point along the composing line, it is preferable to think of the beam "direction" defined by mirror **96** as traveling along the line **102**, or to think of the sweeping of a "potential image" of the selected character along a portion of the line, as there will not be a useful optical image (nor, indeed, any light at all) projected onto the film **104** except when the lamp is fired. The correct position at which the beam direction should lie, when the lamp is fired, is determined (1) by the sequence of character widths called for since the beginning of that line, and (2) by the aggregate of the word spaces including any increments to such word spaces dictated by the necessity for line justification.

To establish the precise position of the sweep at which the lamp is fired, the sweep is monitored by an optical system including the constantly illuminated light source **108** and condenser **110** which illuminates a narrow masked slit at **112**. These parts are disposed slightly above the geometrical axis defined by lenses **116** and **118**, for a reason to be described. The light from slit **112** passes to the fixed focusing lens **116** in support **76**, a movable focusing lens **118** in support **80**, and a first-surface reflector **120** mounted on shaft **98** parallel to reflector **96** already described. The monitor beam is thus scanned in a horizontal plane in the same manner as the projection beam for character imaging, but at a location above the recording film **104**, so that the beam traverses an optical grating **126**, preferably having a large number of alternate opaque and transmitting line areas, so that as the monitor beam scans the grating, a number of pulses will be produced that exactly define the distance of the monitor beam, and hence the composing beam, from a zero position at the starting end of the line format.

The grating effectively covers one longitudinal half of the hypotenuse face of a totally-reflecting prism block **124**, which returns the (now) pulsed or grating-chopped beam generally in the same direction from which it arrived from reflector **120**, but not precisely so, as explained in the next paragraph. Between the grating and the prism block is placed a rectangular-profiled center-slice **122** of a planoconvex lens, to collimate the beam from lens **118** and decollimate it after it has been redirected by the prism.

It will be recalled that slit **112**, forming the object of this portion of the system, was positioned above the geometrical axis of lenses **116** and **118**. Hence, the image rays from slit **112** will arrive at prism block **124** below the geometrical axis, and after total reflection within the prism (whose face height is centered on the geometrical axis), will start their return path at a location above the axis. Crossing the axis between lenses **118** and **116** during their return, the light rays strike a reflector **114** positioned below the geometrical axis, and by it the light is directed laterally to a condenser lens **127** and a counting photocell **128**. The latter is connected to control, ultimately, the instant during the sweeping action at which each character in succession is exposed on the recording film **104**. The crossover optical path just described is detailed in FIG. **6**, simplified by the elimination of the beam deflection due to reflector **120**.

As already indicated, the input to the photocomposing machine is preferably derived from preprepared punched tape of the "Teletypesetter" type, well known to those skilled in the art. To avoid complicating FIG. **1** with the details of the input information paths, these are indicated in FIG. **3** of the drawings, in which the perforated tape as described above is indicated by numeral **130**. A tape sprocket **132** has its drive shaft connected to one output of a tape-reversing drive clutch mechanism **134** driven by a motor **136**, rotation of this sprocket in the direction of its arrow driving the tape in a forward direction beneath a preferably photoelectric code-sensing head **138**. A rapid reverse motion of the tape, back to the beginning of a series of line-composition codes, as sensed by head **138** or otherwise, is obtained by reverse-drive sprocket **140** also powered from the clutch mechanism **134**, so arranged that when either sprocket is being driven, the other sprocket is allowed to idle. To permit rapid reverse motion of the tape without the need to drive the takeup reel system **142** against the takeup torque, a substantial loop of tape at **144** is allowed to accumulate during the forward motion, by proper adjustment of the takeup speed of reel **142** to fit the average tape-takeup speed required in operation.

As already mentioned, and as will be described in more detail in connection with FIG. **9**, the apparatus is cycled so that, at the commencement of a line-comprising cycle, the tape **130** is first scanned or sensed throughout one line-composing segment of its length, the head output being passed to a computer **146** which decodes the character codes, calculates the needed width of composing line space for each, registers these and their totals, adds the necessary allowance for word spaces, subtracts such total line-width requirement from the preassigned length desired for the line, and allocates any line shortage as nearly equally as may be amongst the word spaces for justification. It is noted that the facility for rereading the perforated tape, before actual photocomposition commences, makes it unnecessary for the computer to memorize the actual sequence of character codes, because these will be furnished to it during the second part of the tape-reading cycle. A sharp reduction in memory requirement in the computer can thus be achieved, but it is to be noted that the present invention is not limited to such a double reading of each line section of the control tape, and can in fact be directly controlled by a manual keyboard, if adequate memory capacity is provided in the computer, and if the keyboard is furnished with the usual line-filling indicators, as employed in Teletypesetter keyboarding practice.

The outputs of the computer **146** are indicated in FIG. **3** at **148** and **150**, for the X and Y coordinate positions of the successive characters, and at **152** for the timing of the flash exposure during the sweep of the beam across the receiving film or paper. Another output, indicated at **154**, provides the control for the reversing clutch control mechanism **134**.

A very important and novel feature of the invention lies in the construction and arrangement of parts associated with the font drum **12**, and these parts are accordingly shown to a larger scale in FIG. **4**. The drum **12** is shown as one-piece casting or molding of glass, plastic or other transparent material, having one closed end connected to a stub shaft or quill **156** which scraps into a bore in shaft **161**, carried by a precision ball bearing **158** carried by a suitable bracket **160** on basic support **10**. A flat on the quill ensures approximately correct positioning of the font drum with reference to the shaft **161**, when the quill is inserted, but precise angular positioning is achieved by engagement of a pin **162** on the hub **163** of the shaft **161**, in a registry slot in the end face of the font element. Shaft **161** also carries the electromagnetic detent wheel **37** or equivalent detenting means which ensures that the selected facet of the font drum is in position for scanning by the selecting mirror **16** (FIG. **1**), and the shaft terminates in an Oldham coupling **165** which connects it to the shaft of stepper motor **36**.

The facets of drum **12** are flattened (circumferentially) to avoid distortion of the character images; only one line of characters is indicated in FIG. 4, for clarity. These may be formed on photographic or like strips cemented to the surface of the drum, or one or more strips may be removably attached to provide for occasional "pi" characters. Preferably, the transparent characters are formed by projecting suitable images directly upon photographic emulsion material coated upon the surface of the drum, and developed and fixed in situ thereon. In all cases, the characters are transparent, with an opaque ground or surround. Flash illumination by reflected light is not excluded from the possible modes of operation, however, in which case the characters would be reflective, on a nonreflecting ground.

To the left of the drum 12, FIG. 4 illustrates the xenon flash lamp 42 in the lamp house 166, the light from the lamp being collected by a cylindrical condenser lens strip 168 on to the lenticular face of the prism block 40 which is suitably carried by the forward lamp house wall 170, so that when the lamp house is retracted to the left by sliding along the fixed guides such as 172, ample axial space is provided for the removal of the font drum quill from socket hub 163, when a different font is to be substituted. In a typical case, the font drum, of dimensions given above, will carry 24 facets around its periphery, and 9 characters on each facet, providing an ample font selection of 216 characters.

The block diagram of FIG. 9 shows in simplified fashion the control paths of signals developed both during the initial reading of each tape section, during which the proper word-space width is determined so as to produce a justified line, and also during the second reading of the same tape section (after it has been returned idly to the starting code position) at which time the actual exposure of properly spaced letters and characters is achieved. The initial reading can be accomplished at very high speed, since these signals are being processed entirely by high speed computer circuits without corresponding operation of mechanical parts; thus, the tape may be read at a speed of 300 code groups per second or greater.

During the initial reading of each line section of the tape by the bidirectional tape reader 180 of FIG. 3, which is given the same reference numeral in FIG. 9, each plural-bit character code in turn is stored in the shift register 182. The shift register acts as a buffer for the interim storage of codes and their sequential delivery to the following circuits. Thus, it may provide for the storage of several complete code groups, so that a code group can be read out of the register at the proper time, while another code group is being received therein from the tape reader. As each group is read out of the register 182 in turn to the decoder 184, which, during this initial cycle, recognizes the character (or space) called for by the code group, a corresponding signal is sent to the width encoder 186. Over path 188, all of these width-indicating signals go to the word space computer 190 which adds up the line-space units required by all of the characters to appear in that composed line, subtracts the total from the standard line-length figure; and divides the remainder amongst the number of word spaces that have been registered. The value of the word space that must be provided after each word in that line is thus arrived at, and is stored in the word space register 192. When this has been accomplished during the initial tape segment reading, the tape is returned automatically to the first code of the same line ready for a second reading during which photographic exposure of characters onto the film will occur.

In this simplified description, no account is taken of the possibility that the space in a line required to be taken up by the word spaces may not come out even. The provision for one or more unequal-width word spaces can readily be introduced in ways that will be obvious, if such a refinement is included.

The second reading of the tape section will ordinarily occur at a somewhat slower speed, to accommodate the speed of the mechanical parts described above in connection with FIG. 1. The successive code groups are again buffered through the shift register 182 into the decoder 184, but the latter now also sends a character-identifying signal to the X-Y position encoder 194, which translates the signal into the two coordinates (font drum rotational position and selecting-mirror position) needed to control the presentation of the called-for character to the projection system of FIG. 1. Thus, the encoder sets comparator X to a digital value corresponding to the proper position of selecting mirror 16 (FIG. 1) while the comparator Y is set to a value corresponding to the proper position of font drum 12.

Simultaneously with the commencement of this second reading of the coded tape by the reader 180, the clutch magnet 94 of the drive for the sweep mirror 96 of FIG. 1 has been engaged, starting one continuous sweep of that mirror across the composing line 102. This also initiates a sweep of the mirror 120, so that photocell 128 commences to generate pulses, one for each of the spaces of grating 126. There are a large number of spaces per each inch of grating length, for example a thousand or more, so that (depending upon the point size being composed) there will be thirty or forty or more in each typical character width. As the grating is scanned, the count of pulses since the previous character exposure (indicating the instantaneous position of the character beam direction along the line direction) is stored in counter 196 and presented to the comparator 198.

The registration of beam position in comparator 198, obtained as just described, is constantly being compared with the registration therein of the character-width last called for by the width encoder 186, obtained from the OR circuit 200. As the digital registration of beam position in comparator 198 is increasing, the previously described setting of the font drum 12 and mirror 16 has brought these parts to the proper setting to present the next specified character to the projection optics. When comparator 198 indicates equality between the beam position signalled by counter 196 and that called for by the width encoder 186, the exposure lamp 42 is flashed by the circuit indicated at 202 to expose the selected character in its properly spaced position along the line. The counter 196 is then reset to zero, and shift register 182 operated to supply the next character code to the decoder 184.

Since no exposure is required to compose a word space, the precalculated word spacing stored in register 192 is simply added, by the OR circuit 200, to the width registration in comparator 198 whenever a word space code is recognized in decoder 184. Thus, the following character is exposed on the film at the appropriately spaced position from the preceding character.

There is a stepper drive circuit 204 for the selecting mirror drive indicated by the box labeled 22, 20, and a similar stepper drive circuit 206 for the font drum drive indicated 36. When the respective steppers are energized (by a channel not shown) under the control of the X, Y position encoder 194, they operate the stepping motors until comparators X and Y signal that the selecting mirror and font drum have arrived at the required positions to expose the correct next character, and the stepper drives are then stopped. Connections 208 and 210 from the flash control circuit 202 are indicated to illustrate that these stepper drive circuits are again energized, after each character exposure, assuming the next character called for is a different one. The detailed logical circuitry by which the various possibilities are implemented, such as the feeding out of the next character code from shift register 182, and optionally the driving of the selecting mirror and font in the shortest path (selective direction of rotation) to present the next character, have been omitted from FIG. 9, as unnecessary to an understanding of the invention claimed herein.

In the preferred embodiment described above, the selection of a particular character within a selected row on the font element 12 was accomplished very efficiently by means of a rotatable mirror 16 on an axis centered with reference to the peripheral concavity of the font drum. However, it will be obvious to those skilled in the art that there are other ways of effecting this selection, for example in the case of a font element which is a true cylinder, or such a cylinder except for the flattening of the character row portions, equivalent constancy of focus could be achieved by means of a system including an optical field flattener or like compensating element to allow for the change in object-distance for different positions along the row. Also, with such a cylindrical font element, constancy of focus could be achieved by the use of a movable lens in the following optical system, controlled as to position by the rotations of the mirror. Thus, a rotating selecting mirror **16** is not an indispensable feature of the combination.

At the output end of the overall projection axis, the preferred embodiment utilizes a rotating mirror **96** for placement of the selected characters on the recording element or film **104**. It is clear that the output optical axis could also in effect be translated across the recording film, or as a further alternative the output optical axis could be fixed, and the recording film or cassette translated past the fixed point of impingement of the beam, all without departing from the continuously moving, but cyclically repeated, relative motions of the parts.

In certain of the appended claims, the motion of the reflector **96** is referred to as cyclical by which is meant the repeated sweeping of the reflector to generate successive composed lines of characters on the recording film. It will be realized, by those skilled in the art, that this term is not meant to imply that the successive sweeps are of equal length, because in the composition of lines of different lengths, the length of sweep will vary, as well as the overall repetition rate as between successive long and short sweeps.

While the invention has been described herein in considerable detail, to enable those skilled in the art to practice the same, various modifications in the arrangements will be seen to be possible, and accordingly the invention is not to be taken as limited to the described forms, except as may be required by the scope of the appended claims.

I claim:

1. In a photocomposing machine of the kind including a variable magnification optical system for imaging character representations on a photographic medium, said optical system comprising a pair of axially-adjustable lens elements forming a variable magnification system, the improvement which comprises precisely adjustable position-detenting means for said lens elements, said position-detenting means comprising a threaded guide positioned parallel to the common axis of said lens elements, V-grooved positioning detents on said threaded guide, individual clamping nuts threaded on said rod to secure each of said detents in a precisely adjusted position thereon, a positioning element on each of said lens elements for selective engagement with a respective one of said detents, and means for releasably urging each of said positioning elements into engagement with one of said detents.

2. In a photocomposing machine as described in claim 1, means for selectively locking each of said positioning elements in engagement with a selected one of said detents.