Aug. 21, 1962 S. R. JOHANSON 3,049,968

XEROGRAPHIC REPRODUCTION APPARATUS

Filed March 2, 1959 6 Sheets-Sheet 1

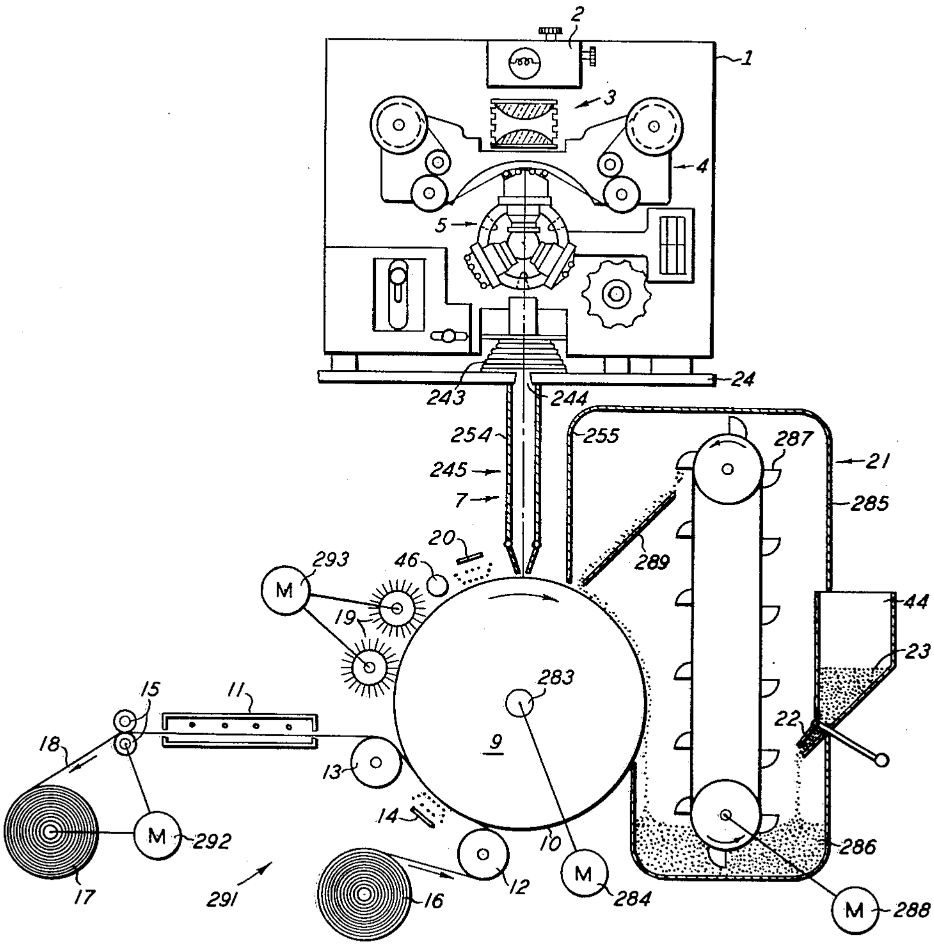

FIG. 1

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BY Norman E. Schroeder

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XEROGRAPHIC REPRODUCTION APPARATUS

Filed March 2, 1959 6 Sheets-Sheet 2

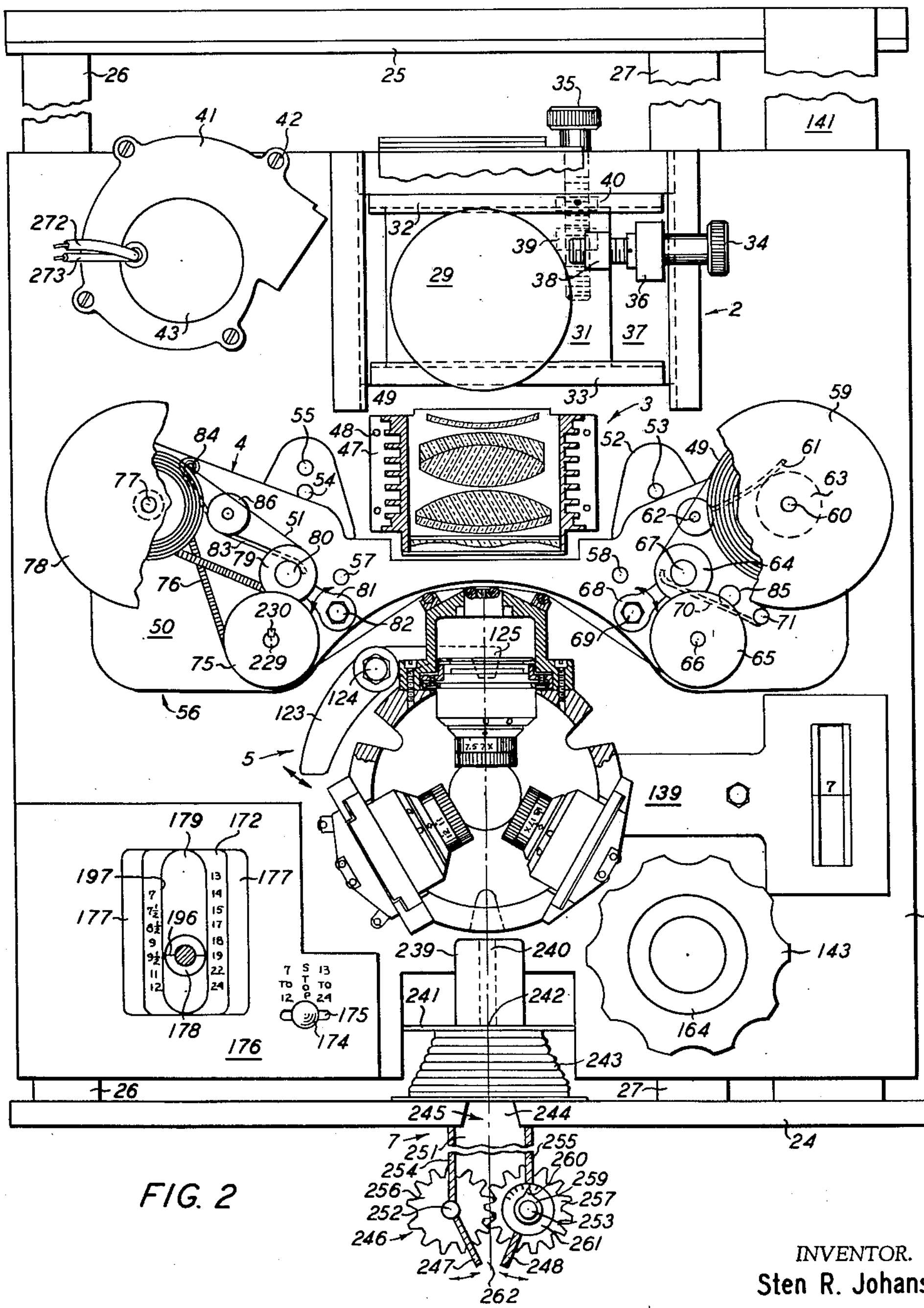

FIG. 2

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XEROGRAPHIC REPRODUCTION APPARATUS

Filed March 2, 1959 6 Sheets-Sheet 3

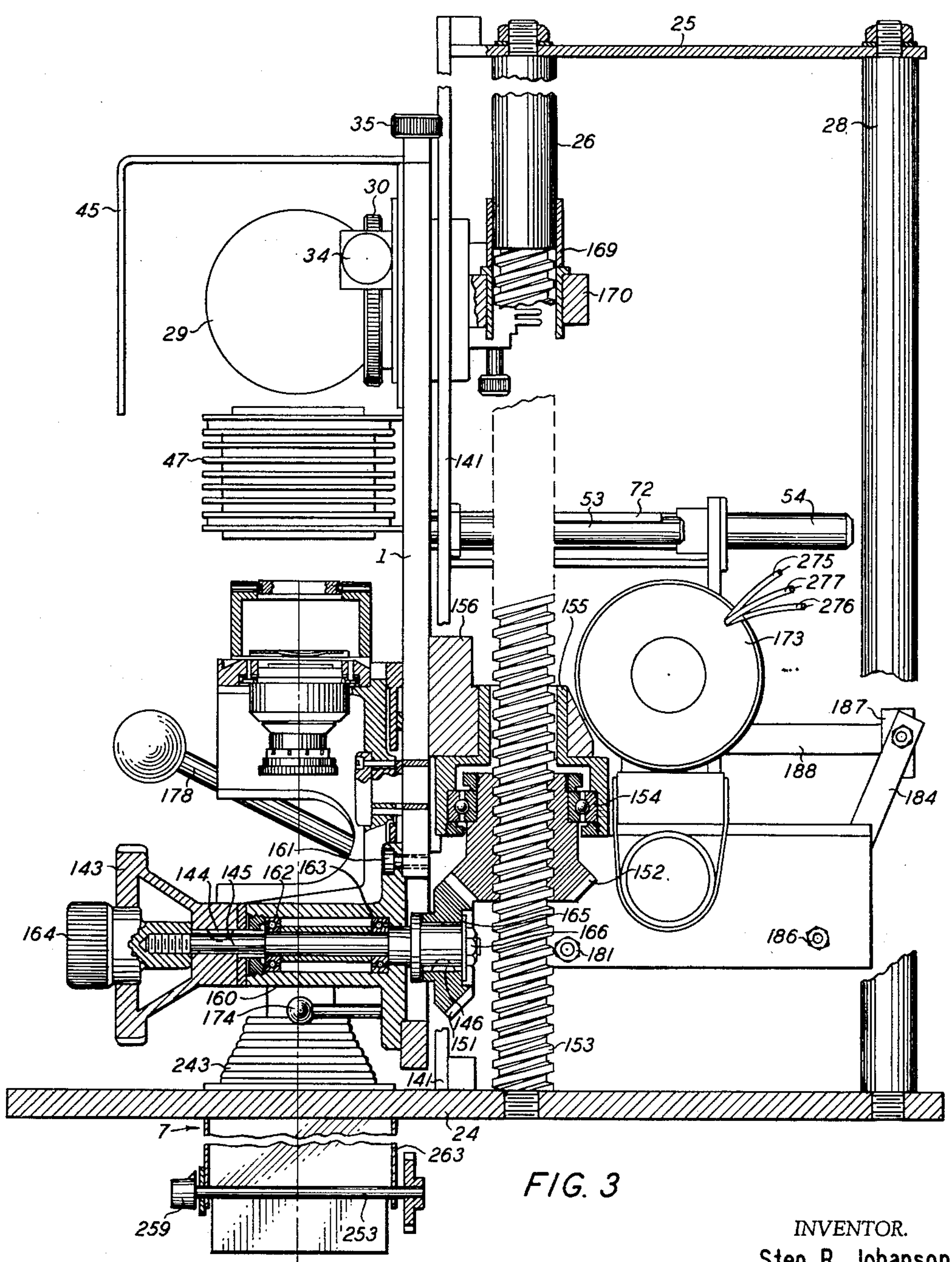

FIG. 3

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XEROGRAPHIC REPRODUCTION APPARATUS

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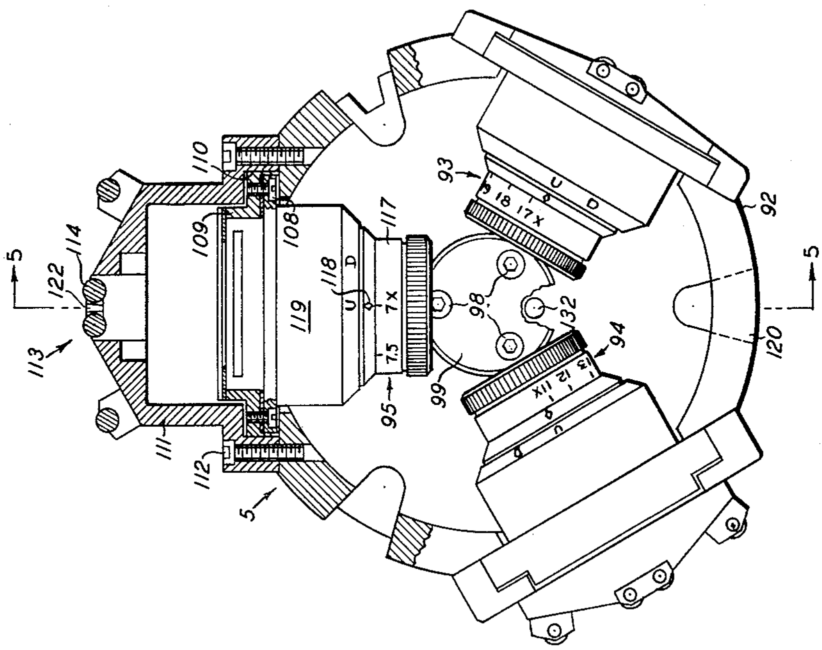

FIG. 4

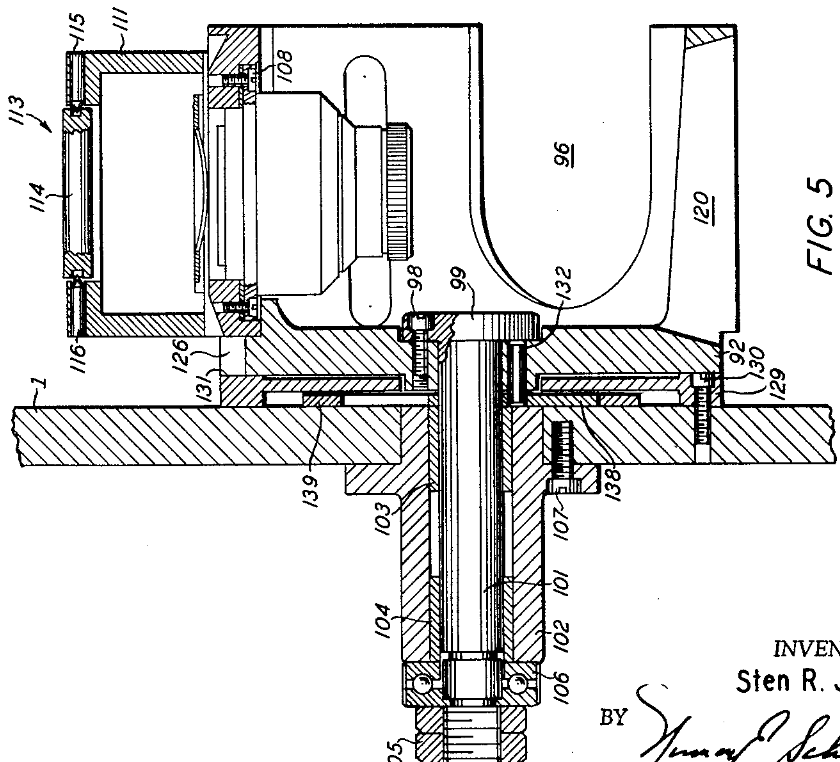

FIG. 5

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Aug. 21, 1962 S. R. JOHANSON 3,049,968

XEROGRAPHIC REPRODUCTION APPARATUS

Filed March 2, 1959 6 Sheets-Sheet 5

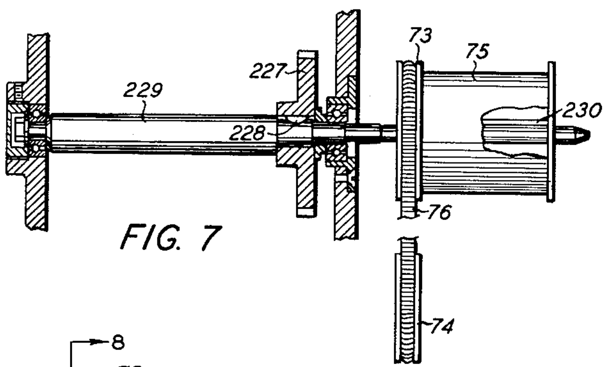

FIG. 7

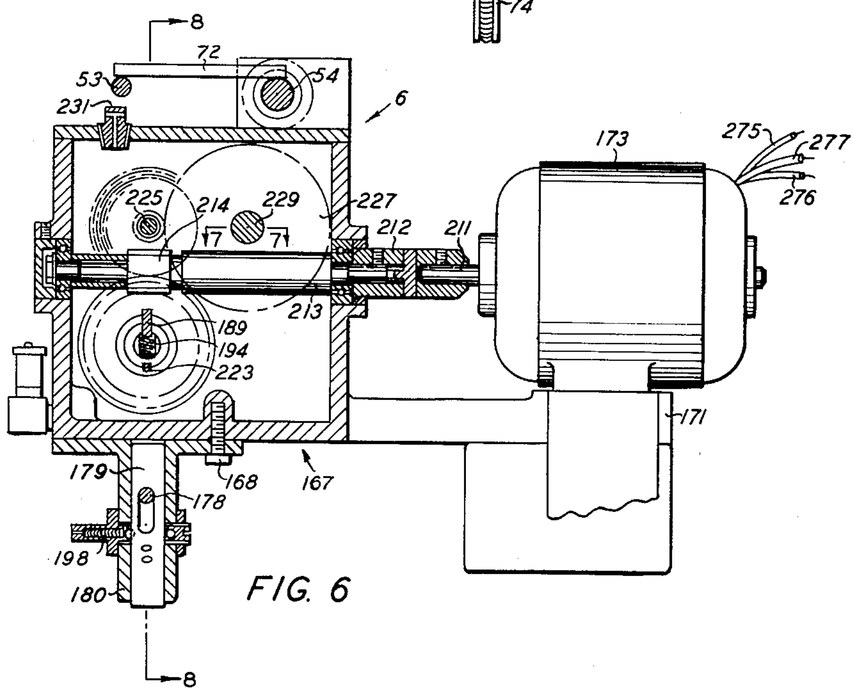

FIG. 6

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XEROGRAPHIC REPRODUCTION APPARATUS

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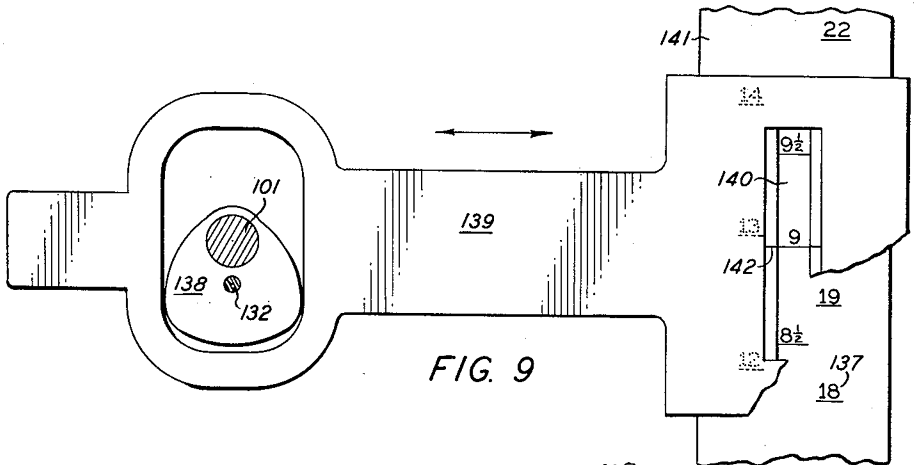

FIG. 9

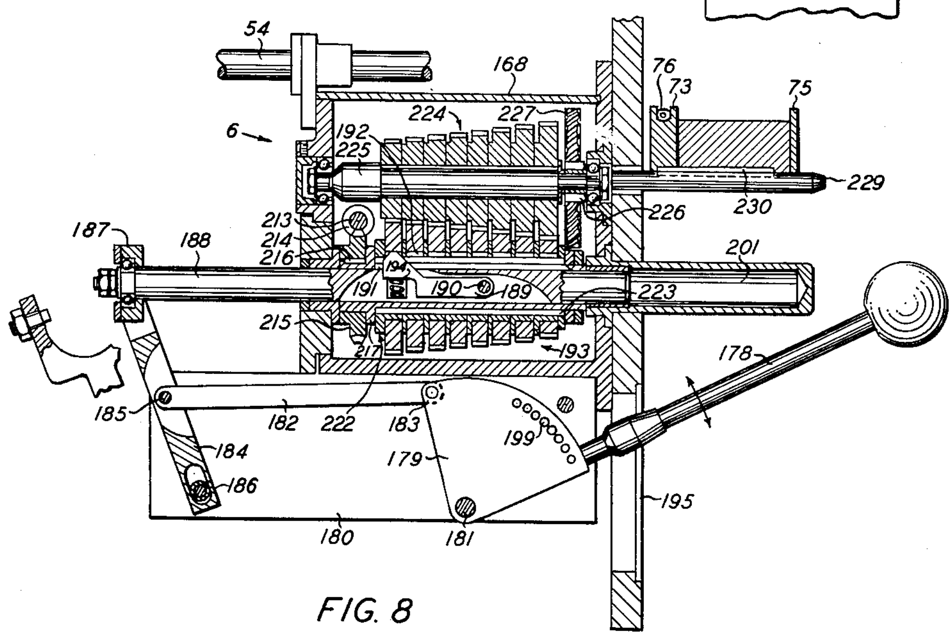

FIG. 8

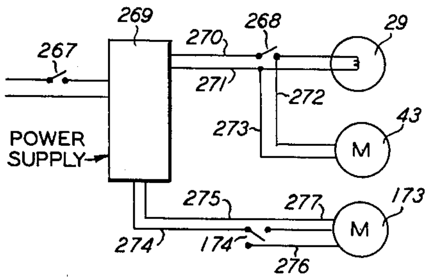

FIG. 10

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United States Patent Office

3,049,968

Patented Aug. 21, 1962

3,049,968

XEROGRAPHIC REPRODUCTION APPARATUS

Sten R. Johanson, Rochester, N.Y., assignor to Xerox Corporation, a corporation of New York

Filed Mar. 2, 1959, Ser. No. 796,561
6 Claims. (Cl. 88—24)

This invention relates to a microfilm projection apparatus and particularly to an improved apparatus to project microfilm images at variable magnification ratios onto an electrostatically charged surface of a xerographic plate which is moving normal to an exposure slit at constant rate. More specifically, the invention relates to improved apparatus for use in conjunction with continuous xerographic printing apparatus for effecting xerographic reproductions at variable magnification ratios from continuously moving microfilm images onto a support surface.

In the process of xerography, for example, as disclosed in Carlson Patent 2,297,691, issued October 6, 1942, a xerographic plate comprising a layer of photoconductive insulating material on a conductive backing is given a uniform electric charge over its surface and is then exposed to the subject matter to be reproduced. This exposure discharges the plate areas in accordance with the light intensity that reaches them, and thereby creates an electrostatic latent image on or in the photoconductive layer. Development of the latent image is effected with an electrostatically charged, finely divided material such as an electroscopic powder that is brought into surface contact with the photoconductive layer and is held thereon electrostatically in a pattern corresponding to the electrostatic latent image. Thereafter, the developed xerographic powder image is usually transferred to a support surface to which it may be fixed by any suitable means.

Reproduction of microfilm images onto a stationary receiving surface has heretofore been achieved by employing conventional projection techniques and the principles of silver-halide photography which may include means to effect magnification between the original and the image projected. Magnified projection of microfilm is usually attained using a single lens of appropriate fixed focal length mounted with its focal axis in an optical path between the filmed image and receiving surface. To effect projection at variable magnification ratios means are provided to vary the length of the optical path and the lens position. To effect a wide range of magnification ratios by these means usually subjects the lens and optical path to a wide range of movement and renders the structure required therefore impractical. As an alternative, lenses of different focal lengths are manually interchanged to reduce the required range of movement. However, apparatus of this type is usually not suitable to automatic machines requiring compactness and rapid conversion over the full range of magnification ratios. In addition, when employing principles of silver-halide photography the photosensitive receiving surface must be processed in accordance with methods well known in the photographic art which for expedient quantity reproduction is usually excessively time consuming and, therefore, considered objectionable for many applications. Because of these reproduction limitations encountered employing conventional apparatus for reproducing from microfilm, the use of microfilm as a medium for recorded storing of printed matter is appreciably limited.

To effect quantity and continuous reproduction of images from moving microfilm, the surface receiving the projected image must also be continuously moving at a synchronized rate. Where it is intended to effect magnified projection the relative movement rates for each selected magnification ratio must be separately synchro-

nized, that is, in a non-magnified projection from continuously moving microfilm, every lineal inch of image projected exposes a lineal inch on a receiving surface moving at the same rate; whereas, in an enlarged magnified projection of two-to-one ratio, the length of film from which the image is projected consumes one-half the moved length of the receiving surface, or in this instance, two inches of receiving surface is exposed per inch of film projected. Therefore, an apparatus to effect projection over a wide range of magnification ratios onto a receiving surface moving at constant rate requires cooperating apparatus enabling an inversely corresponding range of microfilm transport speeds.

The principal object of this invention is to improve means for effecting xerographic reproduction from continuously moving microfilm images onto a support surface at variable magnification ratios. A further object of this invention is to improve means for projecting images at variable magnification ratios from microfilm onto an electrostatically charged surface of a xerographic plate moving at constant rate. A further object of this invention is to improve optical means for conveniently effecting a change of magnification ratios between microfilm images and images thereof projected onto an electrostatically charged surface of a xerographic plate. A further object of the invention is to provide a self-contained apparatus for rapidly and precisely synchronizing relative speeds between transporting microfilm bearing images to be reproduced and a xerographic plate moving at constant rate in accordance with a selected magnification ratio. A further object of the invention is to provide precise means for varying optical path length between a microfilm image to be reproduced and a surface of charged xerographic plate in accordance with a selected magnification ratio.

These and other objects of the invention are attained by means of an improved microfilm projection apparatus which provides optical apparatus for effecting variable magnified projection, apparatus to correlate film rate with the moving rate of a xerographic plate and apparatus for effecting variable plate-to-subject distance all in accordance with a selected magnification ratio.

A preferred form of the invention is shown in the appended drawings in which:

FIGURE 1 is a diagrammatic view of the apparatus of the invention in operative relation with an automatic xerographic apparatus;

FIGURE 2 is a front view of the apparatus of the invention partially broken away to disclose details of the mechanism;

FIGURE 3 is a section view through the apparatus of the invention;

FIGURE 4 is a front view of lens-turret assembly of the invention partially broken away to disclose details of the mechanism;

FIGURE 5 is a section view taken approximately on line 5—5 of FIGURE 4 with lens **93** omitted;

FIGURE 6 is a lateral section view through the variable speed transmission of the invention;

FIGURE 7 is a section view taken on line **7—7** of FIGURE 6;

FIGURE 8 is a section view taken on line **8—8** of FIGURE 6;

FIGURE 9 is a front view of the mask and scale assembly of the invention operative from turret position indicating film-to-plate distance in reference figures corresponding to magnification ratios;

FIGURE 10 is a wiring diagram.

In the arrangement shown, the optical system of the invention is mounted in a box-like housing (see FIG. 1) and includes a lamp source of illumination **2**, a condenser lens **3** to direct concentrated lamp output to the most effective area, a microfilm carriage **4**, a lens-turret assembly 5, variable speed transmission 6 and an exposure control system 7.

The apparatus of the invention is shown in combination with a continuous xerographic apparatus which includes a xerographic plate including a photoconductive layer 10 on a conductive backing and arranged in the form of a cylindrical xerographic drum 9 that is secured to rotatable shaft 283. Drum 9 is rotated at constant rate through the drive action of synchronous motor 284. An electrostatic charging unit 20, which may be of the type disclosed in Walkup Patent 2,777,957, serves to apply a uniform electrostatic charge over surface 10 which is dissipated in part by a light image exposure of a microfilm image to be reproduced by the apparatus of this invention leaving thereon an electrostatic latent image corresponding to the image exposed. Thereafter the latent image is developed by the use of developing unit 21, which may be of a type disclosed in copending application S. N. 393,058, filed November 19, 1953, by Mayo et al., forming a xerographic powder image thereof. Unit 21 includes a housing 285 in which is stored a two-component developing material 286, which may be of a type disclosed in Walkup Patent 2,638,416. Conveyor 287, driven by motor 288, scoops developer material 286 and releases it on slide 289 wherefrom it cascades over the latent image surface 10, adhering to the electrostatic latent image thereon. As developer material is consumed it is replenished by toner additive 23 stored in container 44 at a rate determined by control gate 22.

After development, the image thus formed is transferred to support surface web 18, which may be of paper or any other suitable material. Web 18 is continuously transported from supply spool 16 to take-up spool 17 by paper handling apparatus 291, which may be of a type disclosed in Crumrine et al. Patent 2,781,705. Paper handling mechanism 291 includes a synchronous motor 292 driving take-up spool 17 and drive rolls 15, while guide rolls 12 and 13 serve to direct web 18 into contact against a powder image on surface 10. Electrostatic transfer unit 14, which may be of a type similar to unit 20, generates an electrostatic charge to electrostatically attract the powder image from surface 10 to web 18.

Thereafter, image-bearing web 18 is transported through heat fuser 11, which may be of a type disclosed in Crumrine et al. Patent 2,852,651, serving permanently to affix the powder image thereto. The residual powder image on surface 10 after transfer is removed by brushes 19 driven from motor 293 after which residual electrostatic charge is dissipated by illumination from lamp 46.

The apparatus of the invention has for its basic structural support (see FIGS. 2 and 3) a bottom plate 24 to which is secured front braces 26 and 27 and rear posts 28 (one shown) for supporting top plate 25. Front support wall 1 is secured to the structural support as to be slidably adjustable in a vertical plane. All components hereof having support wall 1 as its primary support are slidable therewith.

Microfilm bearing images to be reproduced is supported on microfilm carriage 4 which includes a film carrier assembly 56 supported from film support carrier 52 which is secured parallel and slidably perpendicular to support wall 1 by rods 53 and 54 extending laterally through support wall 1 and coupled therebehind by plate 72. To position carrier 52 in spaced relation to support wall 1, adjusting bolt 55 is rotatably secured through support carrier 52 and is threaded to support wall 1. Adjustment of bolt 55 effects film centering as required in the operation of the apparatus as will be hereinafter described.

Films of different sizes are interchangeably supported from film carrier assembly 56, having a support wall 50, and which is removably secured by female bolts 57 and 58 to studs (not shown) on support carrier 52. Film supply spool 59 is secured to rotatable shaft 60 in turn secured to support wall 50. Spring 61, pivotally secured about pin 62 secured to support wall 50, maintains a frictional drag on hub 63 of spool 59 effecting a resistance to the movement of film therefrom. Leading from spool 59, film 51 is threaded around rotatable guide roller 64 and thence around rotatable guide roller 65 being secured to shafts 67 and 66 respectively. Pin 67 is secured to pivot arm 68 pivotally secured to support wall 50 by bolt 69 which for film threading, roller 64 is pivoted away from roller 65 as permitted by catch 70 secured by bolt 71 to wall 50. Therefrom film is threaded around guide roller 75 secured to rotative transmission drive shaft 229 through key 230, over guide roller 79 and onto take-up spool 78. Pulley 73 (see also FIGS. 6, 7 and 8) secured also to shaft 229 transmits the speed of shaft 229 through belt 76 to pulley 74 secured to rotatable shaft 77 to which film take-up spool 78 is also secured and is rotative thereby at a rate of rotation determined by the relative rotative rate of shaft 229. Guide roller 79 is rotatably secured to pin 80 of pivot arm 81 which is pivotally secured by bolt 82 to wall 50 and which for film threading is pivoted away from roller 75 as permitted by catch 83 secured by bolt 84 to wall 50. Intermediate support is given to catches 70 and 83 by support means 85 and 86 respectively, each secured to wall 50.

Projection of a microfilm image is effected by lens-turret assembly 5 whereby a lens having appropriate focal length to achieve desired magnification ratio can selectively be obtained. Lens-turret assembly 5 (see FIGS. 3, 4 and 5) includes turret plate 92 secured by bolts 98 to shaft 101 which is rotatably supported through support wall 1 by collar 102 secured thereto by bolt 107 and having internal guide bearings 103 and 104. Lock nuts 105, securing the threaded end of 101, are free to rotate with 101 through the outer race action of thrust ball bearing 106. In preferred form, three lens assemblies 93, 94 and 95 are employed each having an objective lens of different focal length supported within a lens barrel secured by bolts 108 to a backing ring 109. Each of the lens assemblies has a fixed diaphragm opening (not shown) having the equivalent effective aperture of approximately $f/6$. In addition, each is slidably accommodated in turret plate 92 by an opening 96 formed between plate 92 and film track support 111 secured thereto by bolts 112. The film moves on film track 113 which includes a plurality of rollers 114 which may vary in quantity for each lens assembly. Each roller 114 is rotatably supported by a needle pivot 115 and 116 arranged to support the film in the optical axis. Each track spaces the film from its respective lens a distance equal to the lens focal length and film moving thereover is exposed through slit 122 which extends in the direction of drum width with its center in the optical axis of its respective lens.

Each lens in its assembly when arranged to project a microfilm image has its optical axis aligned in the optical path from the image to be projected normal to the drum surface. Each lens in its respective assembly is arranged with its optical axis radial to the axis of turret plate 92 and has its nodal point located on a common radius therefrom. To focus the lens for any magnification ratio attainable, front lens barrel 117 is rotated until a desired magnification ratio has its reference mark aligned with diamond marker 118. To compensate for film thickness dependent upon whether film is moving over film track 113 with emulsion side up or down, a rear barrel 119 is rotatably adjustable until the corresponding "U" or "D" is aligned with diamond marker 118. Whereas many combinations of magnification ratios are attainable with various lenses, in the preferred arrangement it is intended that the lens of assembly 93 will have a 24 millimeter focal length and effect projected magnification ratios of 17×, 18×, 19×, 22× and 24×; the lens of assembly 94 will have a 35 millimeter focal length and effect magnification ratios of 11×, 12×, 13×, 14× and 15×; and the lens of assembly 95 will have a 50 millimeter focal length and effect magnification ratios of 7×, 7½×, 8½×, 9× and 9½×.

A lens which effects a desired magnification ratio can selectively be aligned into the optical path by depressing pawl 123 (see also FIG. 2) counterclockwise enabling free rotation of turret plate 92. Pawl 123, which is resiliently held and rotatable clockwise about bolt 124 secured to wall 1, on release, seats its forward nose 125 in a groove 126 of turret 92 behind a selected lens assembly. Turret plate 92 is then secured in position whereby a lens selected has its optical axis aligned into the optical path, from the image to be projected through the lens, and normal to surface 10. Back support 129 secured by bolt 130 to support wall 1 has a partially ringed polished surface 131 in sliding contact against the rear of turret plate 92 serving to maintain plate 92 in a fixed plane, when rotated thereagainst.

As turret plate 92 is rotated (refer to FIGS. 5 and 9) pin 132, secured between head 99 of shaft 101 and eccentric cam 138, which is rotatable about shaft 101, effects cam rotation. As cam 138 rotates, mask 139 shifts its position laterally so that window 140 exposes a scale of magnification ratios 137 imprinted on focusing plate 141 corresponding to optical lengths attainable with the selectively aligned lens. Index mark 142, imprinted on mask 139, when aligned with the reference line imprinted below an appropriate magnification ratio indicated on focusing plate 141, effects an accurate length setting of the optical path for the magnification ratio selected.

Illuminating source 2, which includes a lamp 29 (see FIGS. 2 and 3), illuminates an area of film image moving over slit 122 on track 113. Lamp 29 preferably utilizes a highly concentrated zirconium arc as its light source, although it is to be understood that other forms of light source having requisite intensity such as incandescent or fluorescent could be used in the alternative. Lamp 29 is supported in an adjustable lamp socket 30 having a knurled periphery to enable adjusting the lamp 29 in and out in relation to support wall 1. Socket 30 is secured to slidable plate 31 in turn secured to cross members 32 and 33. Lateral or vertical adjustment of lamp 29 can be effected independently by means of screws 34 and 35 respectively. Screw 34 is rotatably secured in journal 36 secured to vertically slidable plate 37 with the thread of screw 34 engaging boss 38 secured to plate 31 such that plate 31 can be moved laterally parallel to and in front of plate 37. Screw 35 is rotatably secured in boss 40 secured on the rear of support wall 1 with its thread engaging boss 39 secured to the rear of plate 37, such that plates 31 and 37 and consequently lamp 29 can be caused to move vertically.

To prevent overheating of lamp 29, blower 41 operated by blower motor 43 and secured to support wall 1 by bolts 42 draws air from the surrounding ambient and directs it across the lamp surface. Shield 45 protects the operator of the apparatus from intense radiation of lamp 29.

For concentrating the output of lamp 29, condenser lens 3 includes lens elements 49 secured in condenser assembly 47 in turn secured to front support wall 1 by bolts 48. By proper adjustment of lamp 29 in relation to condenser lens 3, the lamp output of lamp 29 is concentrated at a tangential point on the common radius on which are arranged the lens nodal points of assemblies 93, 94 and 95.

To adjust for the appropriate optical path length, focusing knob 143 (refer to FIGS. 2 and 3) is rotated whereby its movement therefrom is transmitted through shaft key 144 to shaft 145 thence to key 146 to bevel gear 151 having its teeth in continuous mesh with the teeth on bevel gear 152. Gear 152 is internally threaded to mate stationary lead-screw 153 effecting vertical movement when rotated. This vertical movement is transmitted therefrom through thrust ball bearing 154 to sleeve 155 thence to bracket 156 secured to support wall 1 whereby all components hereof which are primarily supported from support wall 1 slide in conjunction therewith and in vertical relation to stationary focusing plate 141. Sleeve 169, secured by bracket 170 to front support wall 1, provides sliding guide support for vertical movement of support wall 1. Bell sleeve 160 secured to wall 1 by bolt 161, provides cantilevered and rotative support for shaft 145 through thrust bearings 162 and 163.

After setting the optical path length, its position may be locked. Locking knob 164 is internally threaded to mate with the threaded end of shaft 145 and on tightening draws shaft 145 and washer 165, secured between a shoulder of shaft 145 and nut 166, to tighten against the inside counterbored face of gear 151.

As stated above, the rate of film movement must be synchronized to the rate of drum rotation for each magnification ratio selected. The rate of film movement is governed by the output speed of variable speed transmission 6 driven by motor 173 (see FIGS. 2, 6, 7 and 8) as transmitted to shaft 229. Motor 173 preferably has two speeds, the appropriate speed of which is selected for a selected magnification ratio by laterally shifting selector switch handle 174 in slot 175 of plate 176 until handle 174 is aligned below the range of magnification ratios imprinted on plate 176 which includes the magnification ratio at which microfilm images are to be reproduced. Coupled to handle 174, so as to be slidable behind plate 176, is mask 177, which on shifting of handle 174 to one of the two operable motor speed positions, exposes a scale of magnification ratios 172 corresponding to transmission settings for attaining synchronized rate of film movement for magnification ratios attainable at the motor speed selected.

To effect appropriate transmission speed, speed selector handle 178 is secured to pivot bracket 179 which is pivotally secured between the parallel walls of brace 180 by journal 181, brace 180 being secured to gear housing 167 by bolt 168. Link arm 182 is pivotally secured at one end to bracket 179 by pin 183 and at its opposite end to pivot arm 184 by pin 185. Pivot arm 184 is pivotally secured at its lower end to brace 180 by journal 186 and is secured at its upper end to ball-bearing swivel 187 secured in turn to rotatable and slidable lateral shaft 188. Pawl 189 is secured internally of shaft 188 by pin 190 so as to slide and rotate therewith. The nose of pawl 189 protrudes through slot 191 of shaft 188 so as to engage a spline 192 in any gear of gear cluster 193. Compressed spring 194, secured within shaft 188, serves to maintain the nose of pawl 189 in continuous contact with a spline 192. Selector handle 178 is operative in a vertical plane through slot 195 and can be accurately set to synchronize film speed corresponding to a selected magnification ratio by setting index line 196 (see FIG. 2) on handle 178 opposite a reference line of the desired magnification ratio on scale 172. The vertical positioning of handle 178 has the effect of sliding shaft 188 into and out of sleeve barrel 201 causing the nose of pawl 194 secured thereto to seat in a spline 192 of a selected drive gear in cluster 193. The position of selector handle 178 is maintained stable by the seating of spring held ball-bearing 198 into a dimple 199 on the surface of bracket 179.

The speed of motor 173 is transmitted through its driveshaft 211, coupling 212, and rotatable longitudinal shaft 213 to worm 214 which is in constant mesh with worm gear 215. Gear 215, keyed through key 216 to bushing 217, transmits the drive motion thereto. A series of individual spacer rings 222 are assembled in juxtaposition to each other being secured to bushing 217 by key 223. Each spacer ring has a drive gear of cluster 193 substantially free floating thereon. Motion of 217 is transmitted therefrom through pawl 189 which acts as a key between 217 and the spline of any gear of 193 selectively determined by the position of selector handle 178. The drive gear drives its meshing gear of gear cluster 224 which are secured to rotatable shaft 225. Also secured to shaft 225 is pinion 226 in constant mesh with gear 227 secured by key 228 (see FIG. 7) on shaft 229 which is rotatably secured in gear housing 167. Guide roller 75 and pulley 73 are each secured to the extended portion of shaft **229** through key **230**. Oil is added to gear housing **167** by removing oil plug **231**.

The primary control over exposure is the exposure system **7** (see FIGS. 1, 2 and 3), which provides a slit opening **262** which partially spans the drum and corresponds to the shutter of a camera in that it is capable of varying the time factor of exposure. When opening **262** is set for maximum width the projected image is in contact with moving drum surface **10** for the greatest length of time allowing the maximum exposure and when set for a minimum the contra is true. Exposure control system **7** includes a light-tight box-like structure **239** substantially rectangular in shape having an enclosed vertical slit **240** extending longitudinally through its center. Box **239** is secured to support plate **241** also having a vertical slit **242** corresponding in configuration to slit **240** wherein the slits are superposed to each other and aligned in the optical path parallel to slit **122**. Secured to the underside of plate **241** is an extensible bellows **243** secured on its bottom side to bottom plate **24** as to completely envelop slit **244** in plate **24**, aligned parallel with slits **240** and **242**. Secured to the underside of bottom plate **24** is hollow light-tight enclosure **245** enveloping the underside of slit **244** and extending vertically downward toward drum **9** having side walls **254** and **255**, front wall **251** and a rear wall **263**. At the lower extremity of enclosure **245** is an exposure control apparatus **246** in which slit **262** is formed by adjustable leaves **247** and **248**, secured to pins **252** and **253**, respectively, which are each rotatively secured to and extend the lateral length of side walls **254** and **255**. Pinions **256** and **257** secured to pins **252** and **253**, respectively, are continually in mesh. Dial **259**, also secured to pin **253**, has a pointer **260** superposed over calibrated scale **261** which indicates the width of opening **262**. By rotating dial **259** clockwise or counterclockwise, the width of opening **262** can be varied.

Referring to FIG. 10, potential is supplied to potential source **269** through standby switch **267** wherefrom it is obtained and conducted through switch **268** to lamp **29** by lead wires **270** and **271**; to blower motor **43** by lead wires **272** and **273**; and conducted to lead wires **274** and **275** through two-speed selector switch **174** thence through lead wires **275**, **276** and **277** to film drive motor **173**.

In operation (see all FIGURES), with all the components of the xerographic apparatus operative, a film carrier assembly **56** is selected which accommodates a desired film size and is secured to film support carrier **52** with bolts **57** and **58** thereby causing guide roll **75** and pulley **73** to engage transmission drive shaft **229**. Film **51** is then threaded from the supply spool **59** around and over the components of carrier assembly **56** onto film takeup spool **78**. Having selected a magnification ratio at which film is to be projected, the operational procedure is as follows: Assuming, for example, a magnification ratio of "7" has been selected, pawl **123** is rotated counterclockwise about **124** until its nose **125** releases turret plate **92** free to rotate about its center axis. For a selected ratio of "7," turret plate **92** is rotated until pawl nose **125** seats in groove **126** behind lens assembly **95** which is indexed as having the proper lens to effect a magnification ratio of "7." This position of assembly **95** aligns the optical axis of its lens into an optical path normal to surface **10**, and also positions film track **113** as to place film **51** on assembly **56** in contact therewith as shown in FIG. 2. Barrel **117** is then rotated until the "7" reference mark coincides with the lower tip of diamond **118** thereby focusing the lens. Barrel **119** is then rotated as a function of whether film is to transport over track **113** with emulsion side up or down so that the "U" or "D" respectively coincides with the upper tip of diamond marker **118**. Rotation of turret plate **92**, through the action of cam **138**, causes mask **139** to shift laterally until window **140** exposes a scale of magnification ratios on focusing plate **141** which includes the specific ratio "7." Locking knob **164** is rotated counterclockwise so as to release focusing knob **143** for adjustment. Knob **143** is then rotated, clockwise or counterclockwise, serving to raise or lower support wall **1** with components secured thereto. Rotation of **143** is continued until index mark **142** on mask **139** aligns with the reference line imprinted on focusing plate **141** below magnification ratio "7," Film tract **113** will have been raised or lowered so as to cause film **51**, under tension thereto to be vertically spaced the requisite optical path length between film and surface **10**. After adjustment is effected, locking knob **164** is rotated clockwise to lock the adjustment. Film drive motor selector switch **174** is then shifted laterally left of "stop" position to effect appropriate motor speed for a magnification ratio of "7." Shifting of **174** causes mask **177** to shift correspondingly so as to expose only the appropriate magnification ratio scale **172** which includes the ratio "7." Transmission selector handle **178** is shifted vertically until index line **196** aligns opposite the reference line **197** of ratio "7." Standby switch **267** is then closed whereupon lamp **29** can be energized by closing lamp switch **268**. By turning the appropriate adjustment screws **34**, **35** and/or socket **30**, the output of lamp **29** can be focused through condenser lens **3** so as to effectively illuminate the image on film **51** in the optical path. Rotating dial **259** of exposure system **7** enables setting controlled exposure of image to surface **10**. Centering of copy on the transfer material **18** is effected by rotating bolt **55**.

With use of the apparatus thus described, when used in conjunction with continuously operative xerographic printing apparatus, continuous xerographic reproductions are produced at variable magnification ratios from images of moving microfilm in approximately 15 seconds. With the apparatus of the invention, rapid and accurate synchronization between film to drum speed, film to surface distance, and lens focusing can easily be effected to project at a desired magnification ratio from a microfilm image onto an electrostatically charged drum surface.

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 shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. In a xerographic unit in which images are projected from continuously fed microfilm onto a xerographic plate moving at constant rate normal to a transverse exposure slit spaced from the plate, wherein said unit includes means adapted to feed microfilm at a predetermined rate relative to the plate movement to pass the film in projection relation to an optical system which has its optical axis disposed to extend through said slit normal to the plate; apparatus to effect image projection at variably selective magnification ratios including in combination an optical projection system mounted on a support member that is adapted to be moved normally toward or away from the xerographic plate, said optical system including a turret rotatively mounted on the support member, a plurality of different focal length objective lenses for different magnification ratios of image projection, each of said lenses being supported in said turret with its optical axis arranged radial to the turret axis of rotation, whereby any of said lenses can selectively be set into operative position in the optical axis by selective rotation of said turret, said optical projection system also including a projection lamp and a condenser lens system mounted on the support member in spaced relation to the turret axis of rotation for projecting a light beam through the objective lens arranged in operative position, film support means mounted in said support member and arranged to support microfilm in operative spaced relation to the lens in operative position; presettable variable rate feed means adapted to effect film feed at a relative predetermined rate

proportional to the ratio at which image magnification is to be effected, and a presettable drive mechanism connected to the support member to move said support member to position the optical system relative to the xerographic plate in accordance with the ratio at which image magnification is to be effected.

2. The apparatus of claim 1 in which there is included indicating means to guide the setting of said mechanism, said indicating means including a plurality of scales fixedly supported relative to the movement of the optical system, each scale having graduations different from said other scales and that correspond to focal positions for the different of said lenses, a mask operatively responsive to rotation of said turret to selectively expose the scale having graduations for the magnification ratios attainable by the lens in operative position, and means to correlate the focal position of the optical system with said exposed scale.

3. The apparatus of claim 1 in which the variable rate feed means includes a presettable variable speed transmission.

4. The apparatus of claim 3 in which the variable rate feed means also includes a presettable variable speed motor to drive said transmission.

5. The apparatus of claim 1 in which at least one of said lenses is focusable through a range of projection ratios.

6. The apparatus of claim 1 wherein the objective lenses supported in the turret are arranged in a manner such that the nodal point of each lens is equidistant from the axis of rotation of the turret.

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