Feb. 27, 1962 E. K. SMITH, JR., ET AL 3,022,716

PHOTOPRINTING APPARATUS

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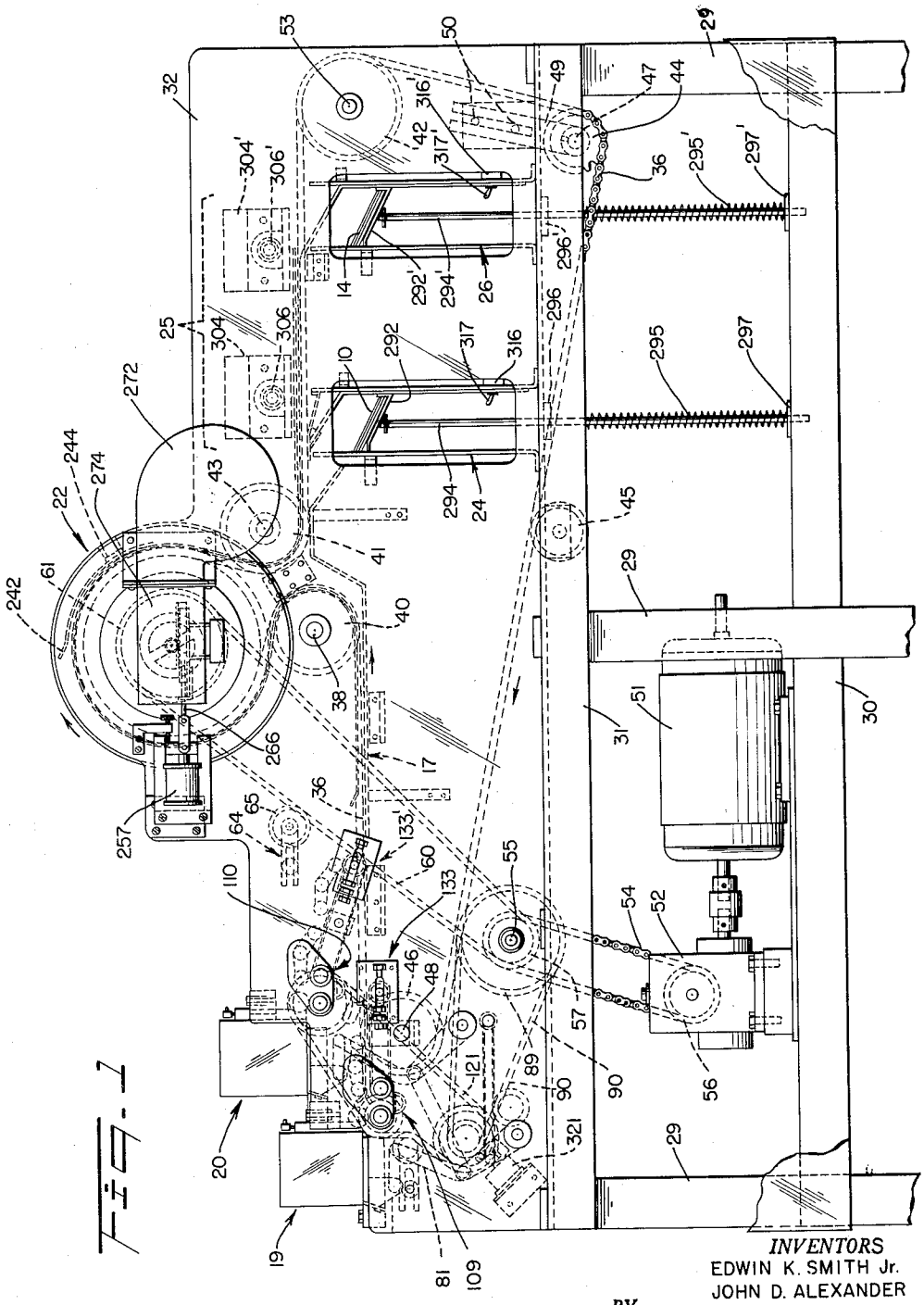


Fig. 1

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PHOTOPRINTING APPARATUS

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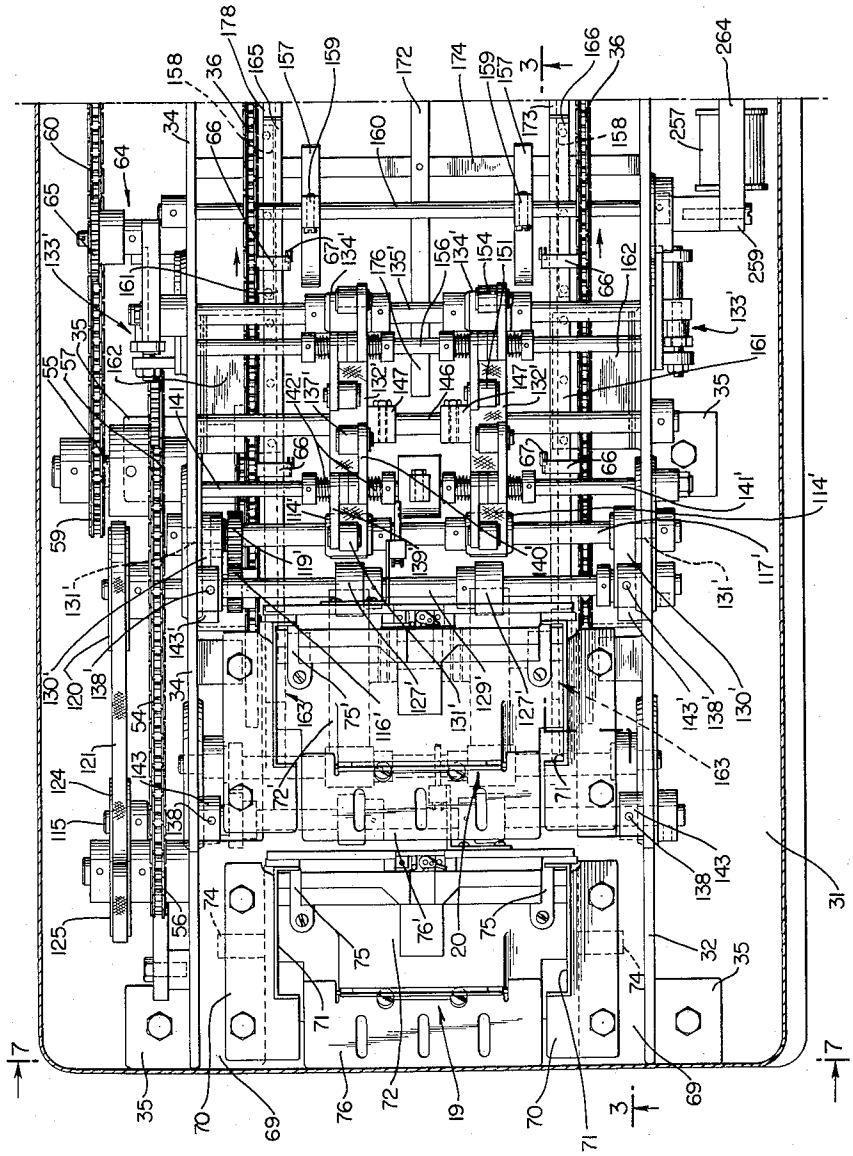


FIG. 2a

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PHOTOPRINTING APPARATUS

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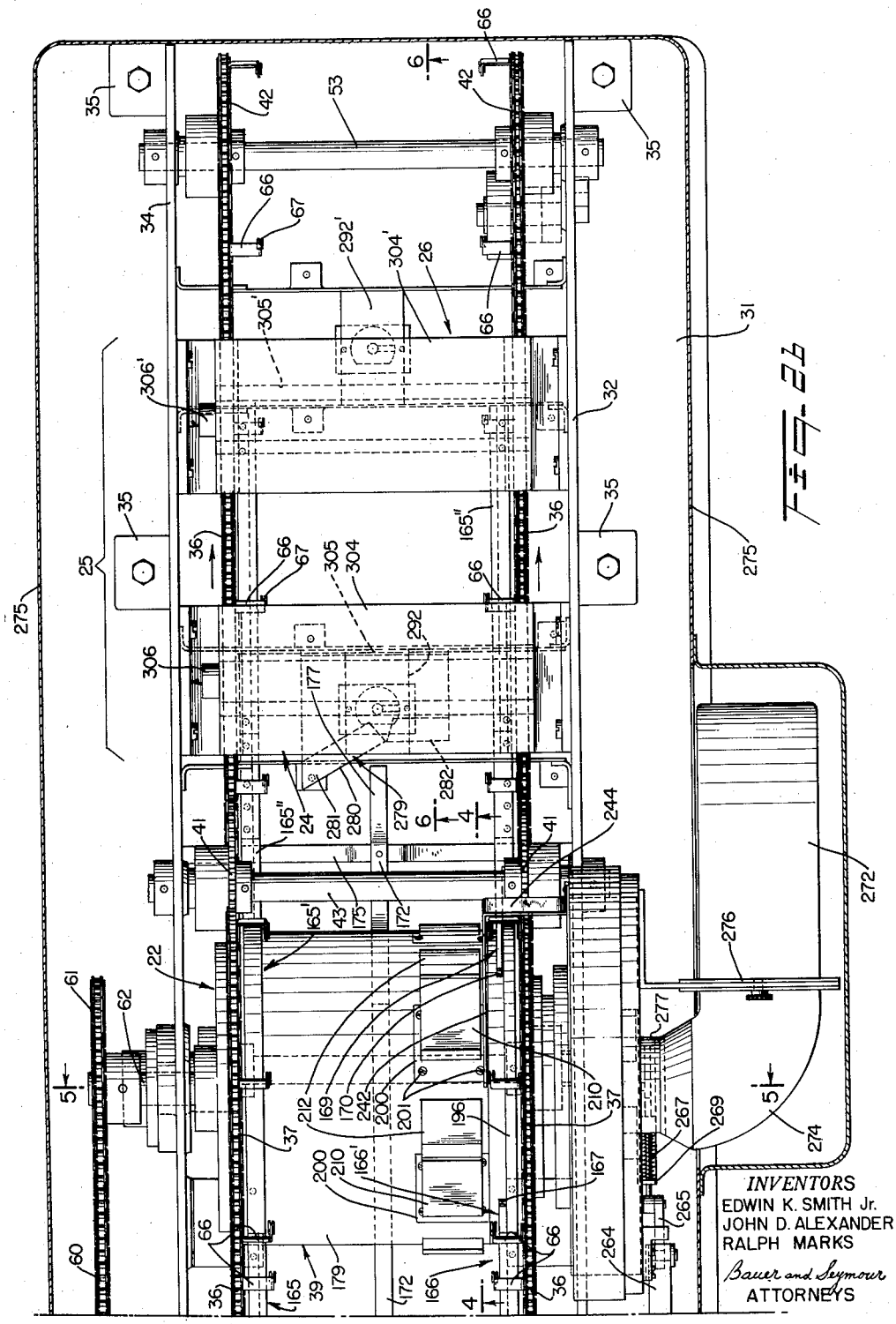


FIG. 27

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PHOTOPRINTING APPARATUS

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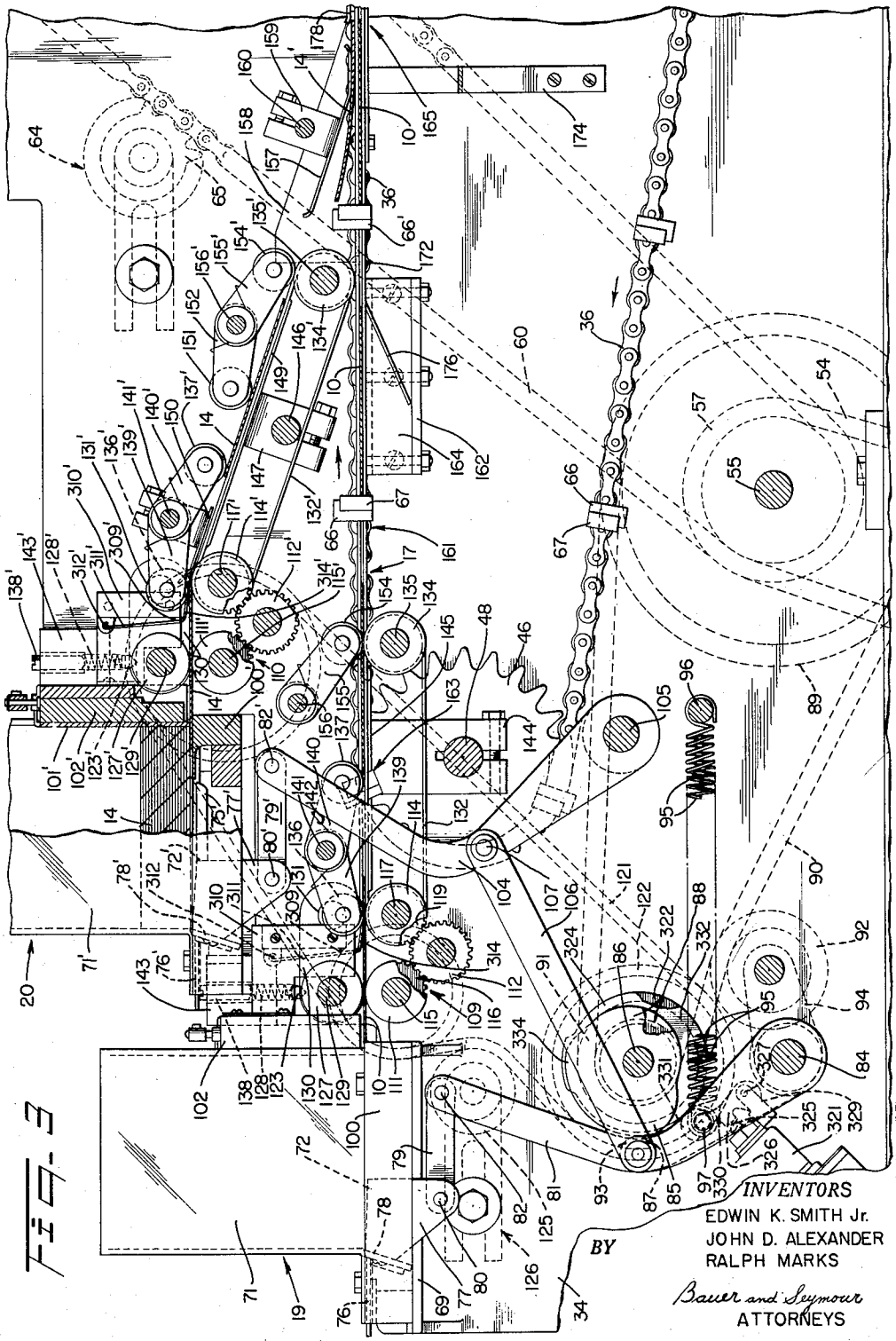


FIG. 3

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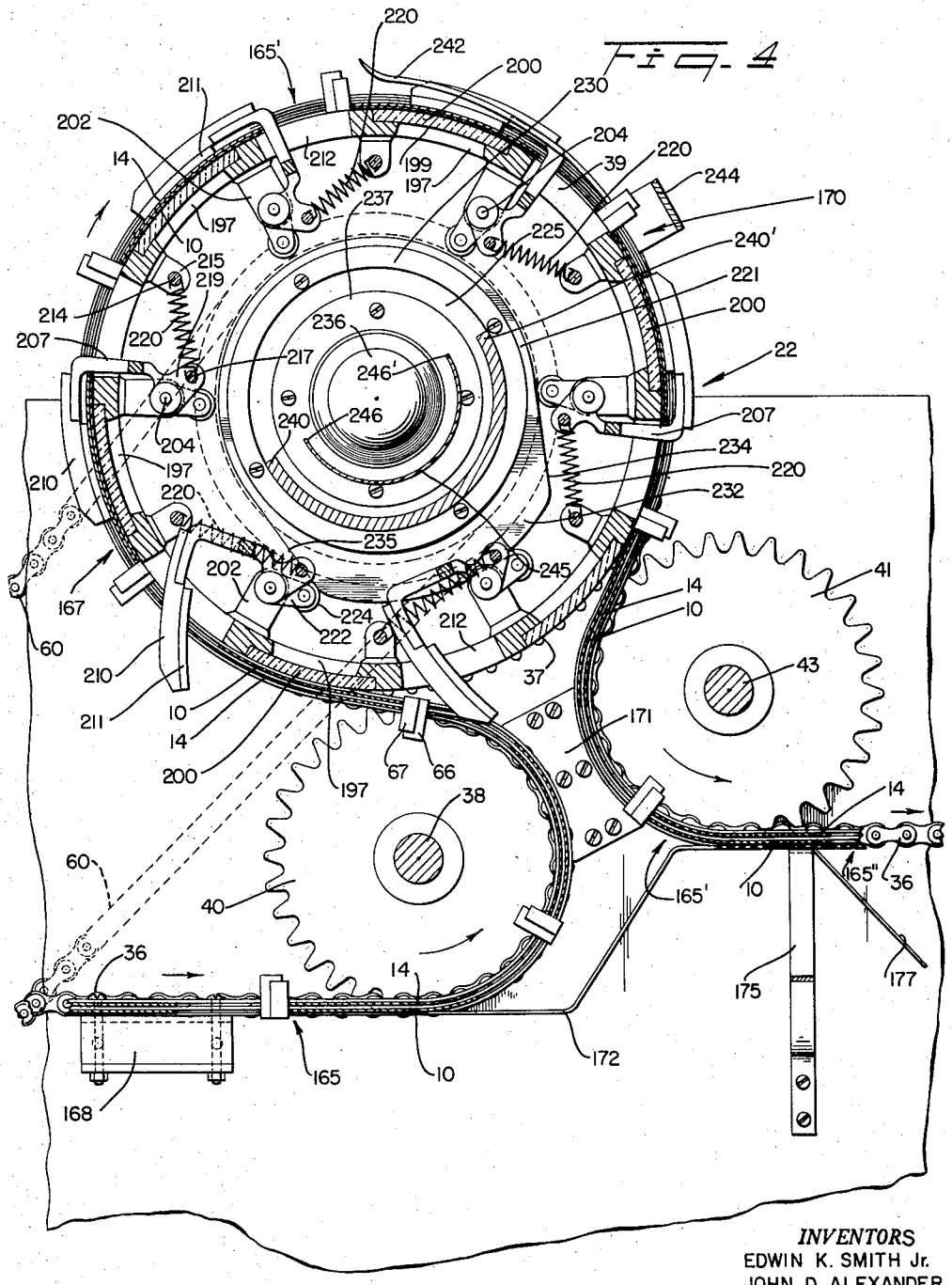
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Fig. 4



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Fig. 4a

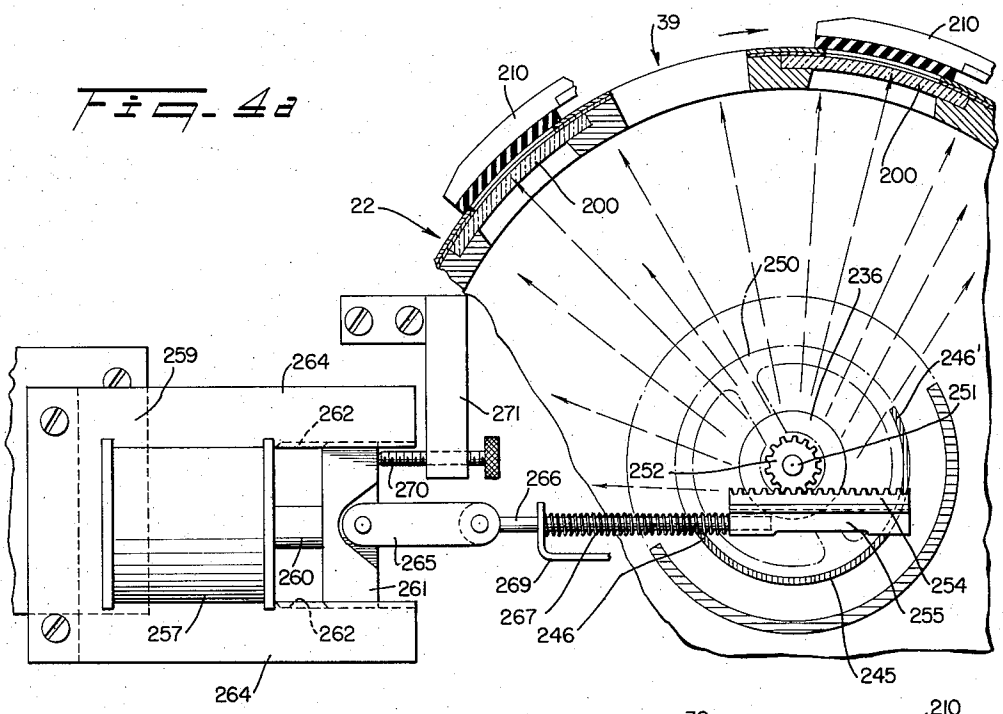
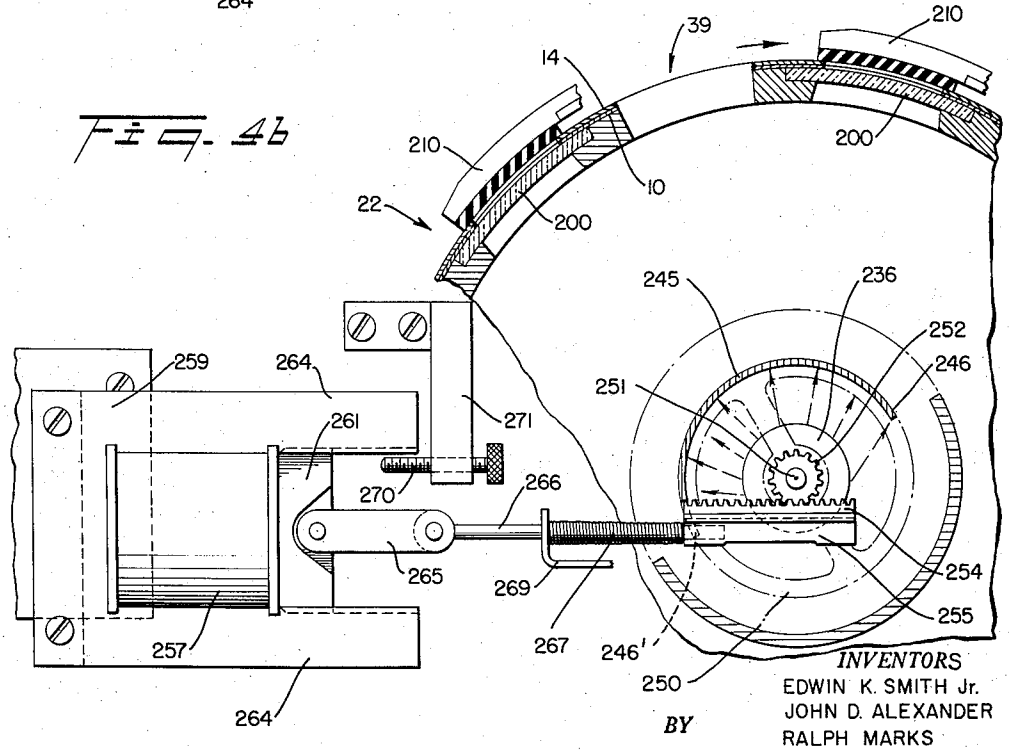


Fig. 4b



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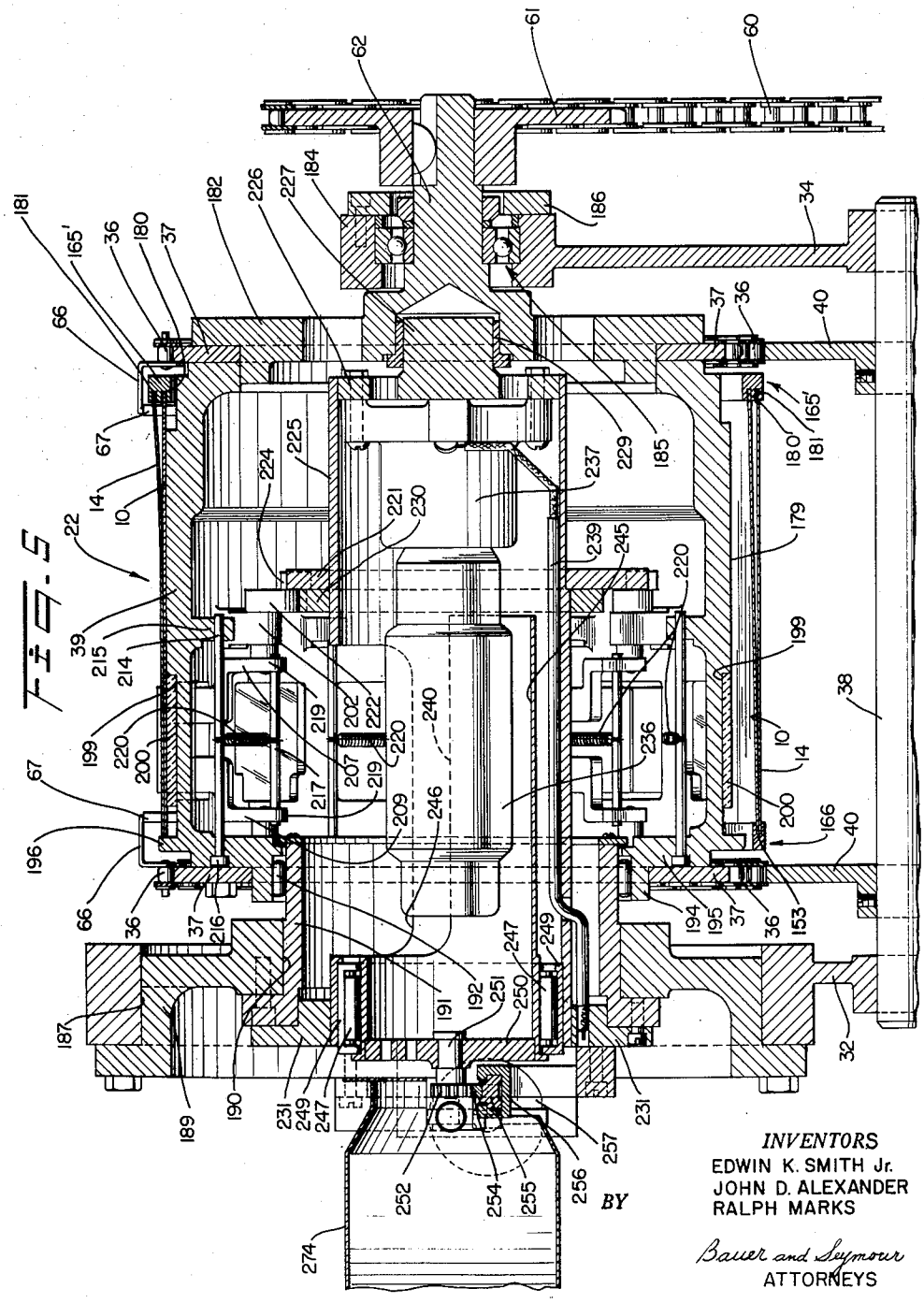


FIG. 5

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PHOTOPRINTING APPARATUS

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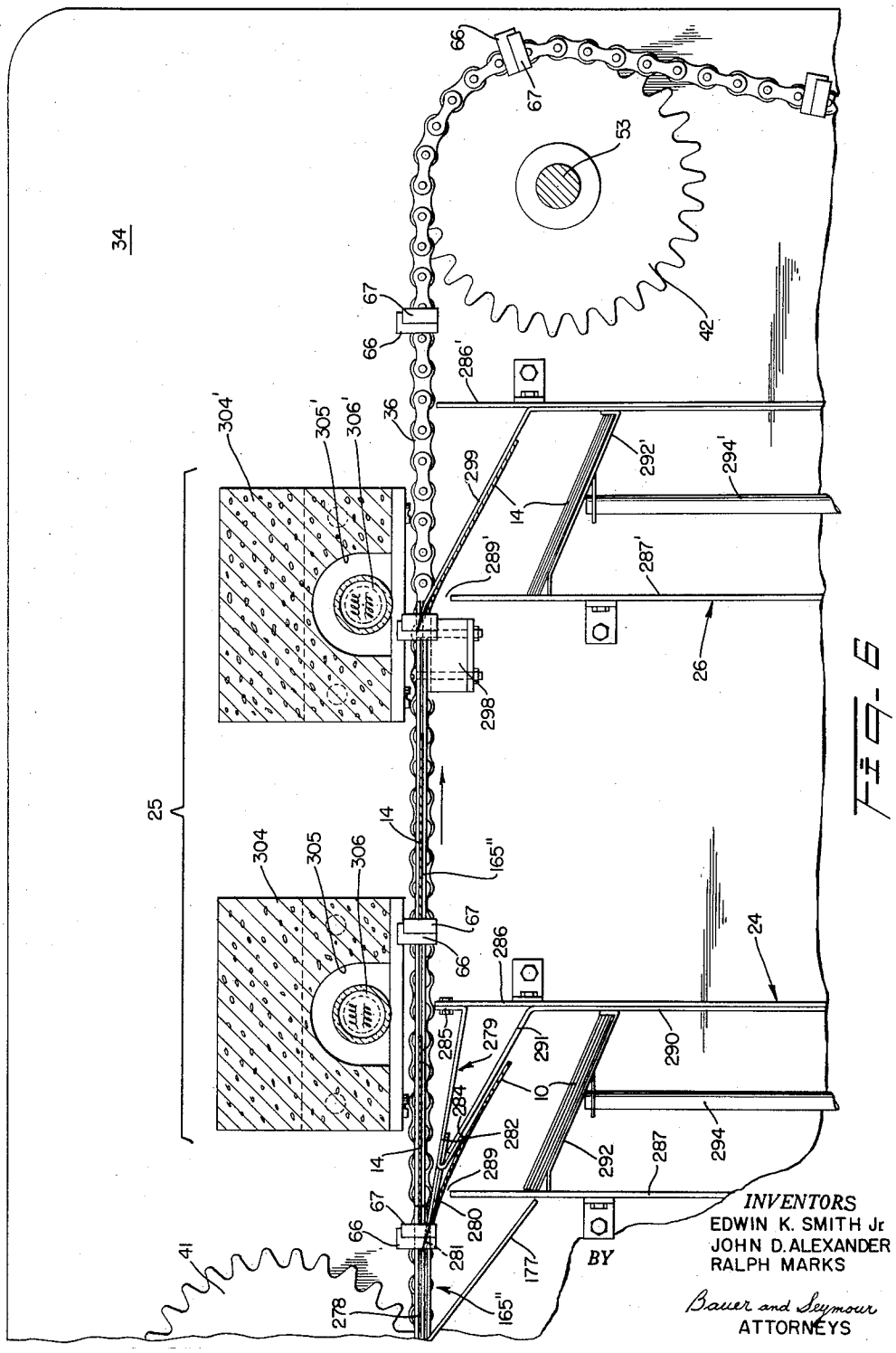


FIG. 6

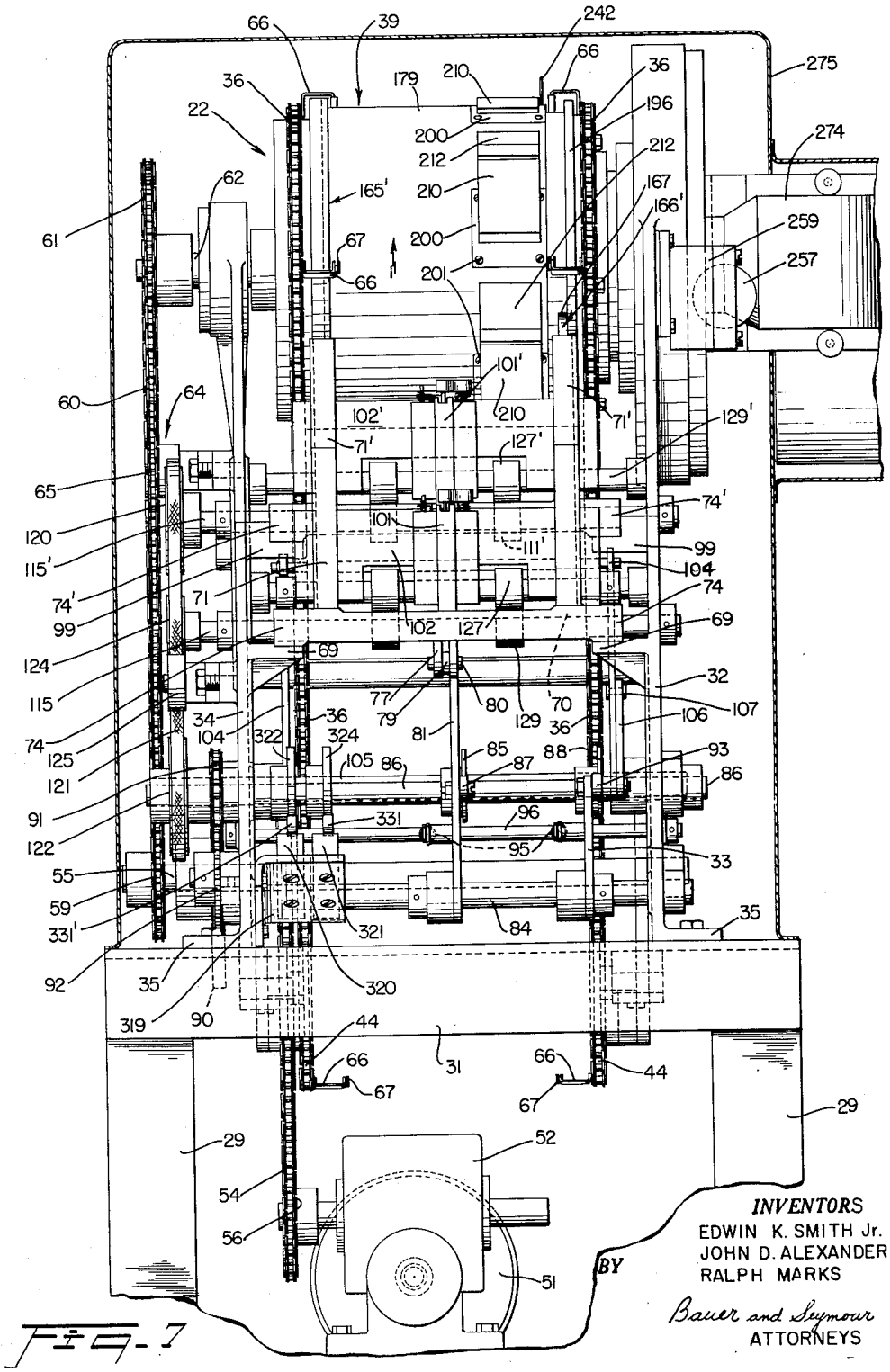
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PHOTOPRINTING APPARATUS

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FIG. 7

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PHOTOPRINTING APPARATUS

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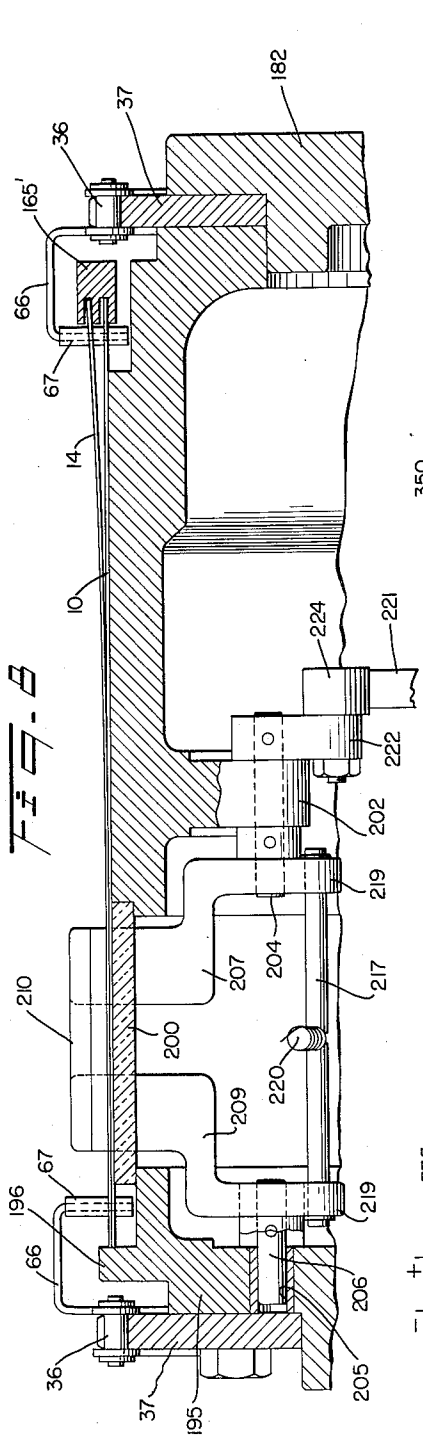


Fig. 8

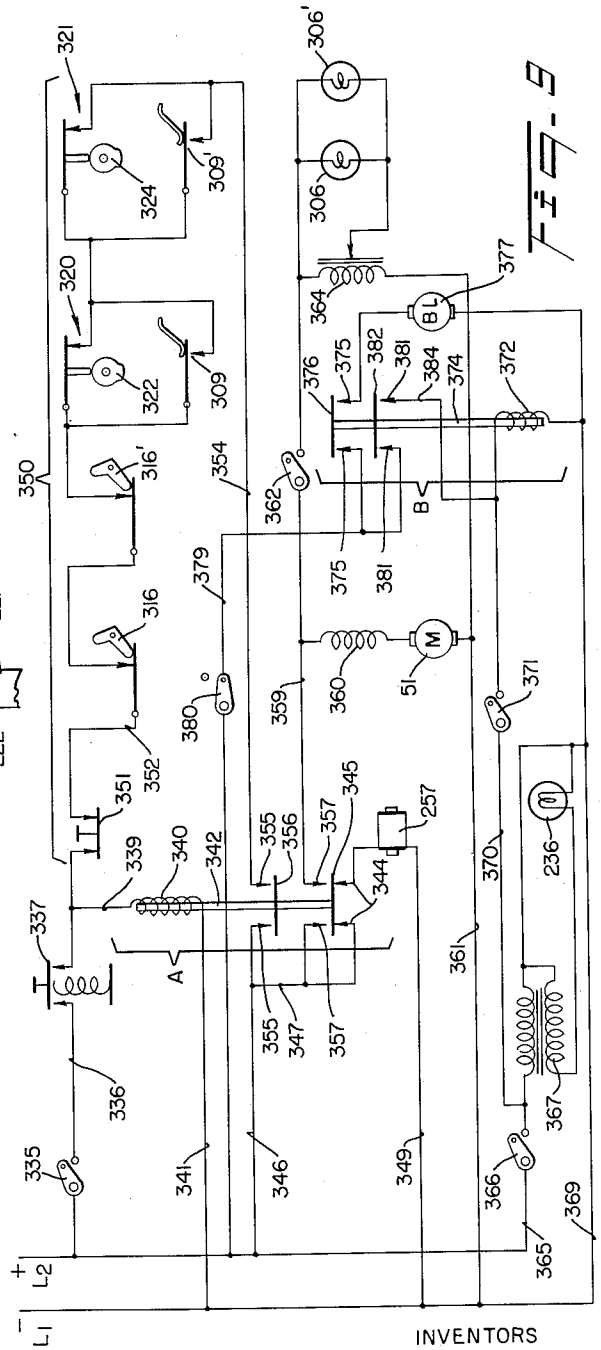


Fig. 9

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PHOTOPRINTING APPARATUS

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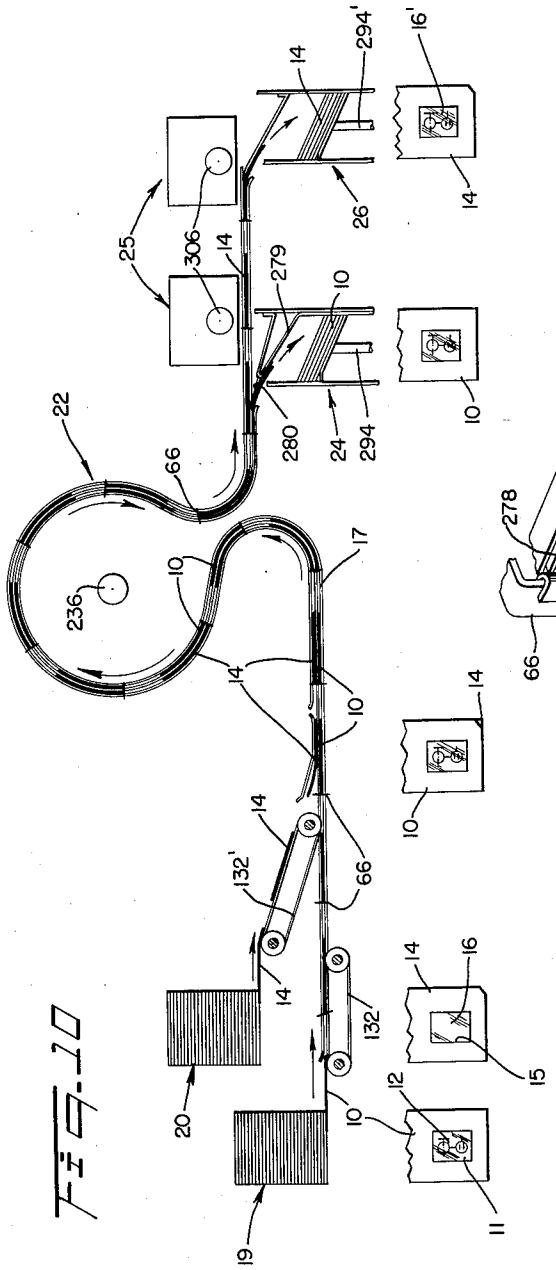


FIG. 10

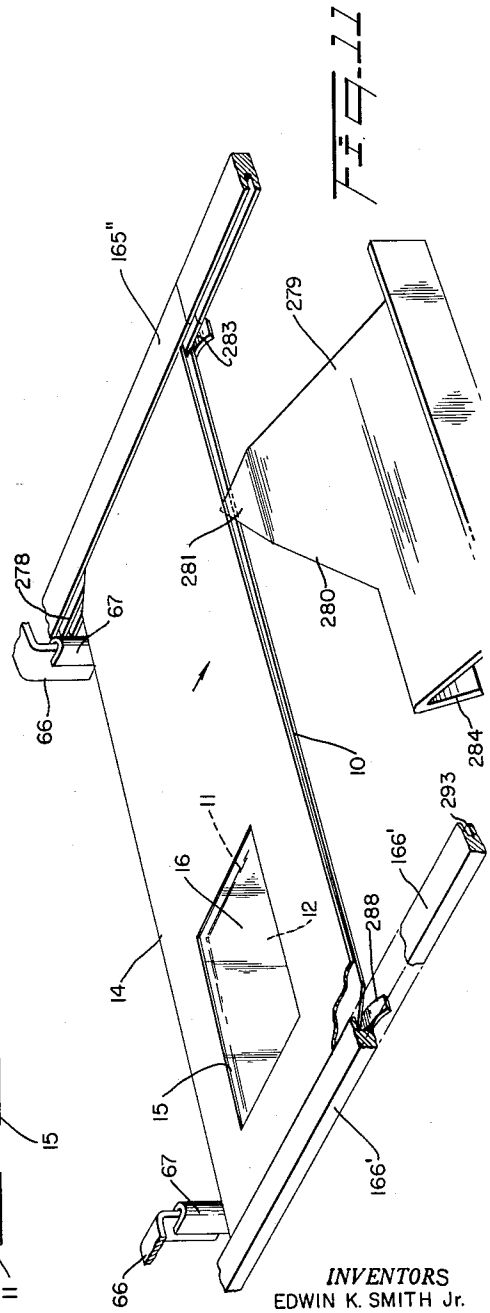


FIG. 11

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United States Patent Office 3,022,716 Patented Feb. 27, 1962

3,022,716
PHOTOPRINTING APPARATUS

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Filed May 1, 1957, Ser. No. 656,316
27 Claims. (Cl. 95—77.5)

This invention relates to a method of and an apparatus for photographically reproducing film sections, such as sections of microfilm mounted in aperture cards.

One of the objects of the present invention is to provide a novel method of feeding original or master film sections and unexposed film sections, superimposing the master and unexposed film sections in accurate registry, and feeding the sections in such relationship past a photoprinter.

Another object of the invention resides in the provision of a novel method of feeding master and duplicate cards bearing film sections located remote from at least one end of each of the respective cards past a photoprinter with the film sections of the respective cards superimposed and in contact, and of separating the master and duplicate cards after such exposure at the printer, whereby the master cards may be conveniently stacked and the duplicate cards may be developed and stacked.

A further object of the invention is to provide novel apparatus for feeding original or master film sections in spaced relationship, for feeding unexposed film sections in spaced relationship, for superimposing each unexposed film section in accurate registry with a master film section, and for feeding the sections together in such relationship past a photoprinter.

Yet another object of the invention lies in the provision, in apparatus of the character indicated, of novel mechanism for feeding superimposed master and duplicate cards bearing film sections remote from at least one end of the card in accurate registry past a photoprinter with the film sections of the respective cards held firmly in contact, and for separating the cards after exposure at the printer.

Still another object is to provide, in apparatus of the character indicated, novel card conveying and registering mechanism by means of which the cards are superimposed on a conveyor and are continuously carried by the same conveyor past the photoprinter.

A further object of the invention lies in the provision of novel card-handling mechanism adapted for use with apparatus of the indicated type and with cards in which the film sections are located remote from at least one end of the cards, the mechanism being of such character that the film sections of the superimposed master and duplicate cards are pressed into contact in their passage past the printer and the ends of the superimposed cards remote from the film sections are held spaced so as to facilitate separation of the cards after they pass the printer.

Still another object is to provide, in apparatus of the indicated character, a novel combination of a card supporting and locating conveyor with a photoprinter having an outer card-supporting surface movable in synchronism wtih the conveyor and also having a succession of film section gripping and pressing platens which operate in synchronism with the conveyor.

Yet another object is the provision of a novel photoprinter of simple rugged construction which insures the holding of the film sections of superimposed master and duplicate cards in accurate registry.

Another object resides in the provision, in apparatus of the character indicated, of novel mechanism for controlling the apparatus, including means for stopping the conveyor if either a master or a duplicate card is not delivered correctly to the proper pocket on the conveyor, and mechanism for stopping the exposure of the card at the printer under such circumstances.

Still another object is to provide, in one embodiment of the invention useful with thermally developed film sections, of apparatus as set forth in the preceding paragraph in combination with a heater-type developer, in a preferred embodiment, such apparatus including means for shutting off the developer when either a master or a duplicate card is not fed properly to its pocket on the conveyor.

The above and further objects and novel features of the present invention will more fully appear from the following detailed description when the same is read in connection wtih the accompanying drawings. It is to be expressly understood, however, that the drawings are for the purpose of illustration only and are not intended as a definition of the limits of the invention.

In the drawings, wherein like reference characters refer to like parts throughout the several views,

FIG. 1 is a view in side elevation of one form of photoprinting apparatus constructed in accordance with the present invention, certain of the parts located interiorly of the housing being shown in phantom lines, certain portions of the housing of the apparatus being broken away;

FIG. 2*a* is a view in plan of the card-entering end of the apparatus, the top of the housing being removed along a horizontal sectioning plane;

FIG. 2*b* is a view in plan similar to FIG. 2*a* but showing the remainder of the apparatus, the upper portion of the housing likewise being removed by a horizontal sectioning plane;

FIG. 3 is an enlarged fragmentary view in vertical longitudinal section through the card-entering end of the apparatus, the section being taken along the line 3—3 of FIG. 2*a*, certain of the parts being shown in side elevation;

FIG. 4 is an enlarged fragmentary view in vertical section through a portion of the apparatus at the printer or exposing unit, the section being taken along the line 4—4 of FIG. 2*b*, certain of the parts being shown in side elevation;

FIG. 4*a* is an enlarged fragmentary and somewhat schematic view in vertical section through the drum of the exposing unit, the view showing the selectively operated shutter of the unit in open position, the shutter-operating solenoid being shown in side elevation;

FIG. 4*b* is a view similar to FIG. 4*a* but with the shutter at the exposing unit in closed position;

FIG. 5 is a view in transverse axial section through the drum of the exposing unit, the section being taken along the line 5—5 of FIG. 2*b*, certain of the parts being shown in side elevation;

FIG. 6 is an enlarged fragmentary view in vertical longitudinal section through the apparatus at the exit end of the apparatus where the cards are separated and the duplicate cards are developed, the section being taken along the line 6—6 of FIG. 2*b*;

FIG. 7 is a view in end elevation of the apparatus taken from the card-entering end, thereof, the housing about such apparatus being broken away along a vertical sectioning plane indicated by the line 7—7 of FIG. 2*a*;

FIG. 8 is an enlarged fragmentary view in vertical axial section through the top of the drum of the exposing unit, the section being taken generally along the same sectioning plane as that of FIG. 5;

FIG. 9 is a wiring diagram of the control system for the apparatus, certain elements such as motors, switches, etc. being shown schematically;

FIG. 10 is a schematic view in the nature of a flow-

sheet indicating the successive steps performed by the apparatus; and

FIG. 11 is a fragmentary view in perspective of the portion of the apparatus at the card-separating zone thereof, such view showing the manner in which the master and duplicate cards are held by the edge guides therefor, and also the manner in which the card-separating plow or shoe cooperates with the thus held cards.

Referring now to the drawings, there is shown by way of example one form of apparatus constructed in accordance with the present invention. Such apparatus, as will be more readily understood after consideration of FIGS. 1 and 10, includes mechanism for feeding a series of master or original film sections, shown as inserts in a series of similar cards, onto a conveyor, feeding a succession of similar cards onto the conveyor so that they be superimposed one on each master card, and feeding the thus superimposed cards past a photoprinter. After passing such printer the master cards are separated from the duplicate cards, the film sections of the duplicate cards are developed, and both master and duplicate cards are collected in separate stacks. The cards shown are apertured cards of the record type commonly employed in connection with known and existing record card tabulating and sorting systems and machines, the film sections being frames of microfilm mounted in the apertures of the cards. It will be understood, however, that the present invention is not limited to the printing and developing of film sections mounted in cards of the statistical or tabulating machine type, since other forms of record or catalog cards, as well as ordinary cards, may be used for this purpose. Additionally, apparatus in accordance with the present invention may be used to advantage in the printing and developing of various other types of film sections, including film sections which are not mounted in cards or similar supporting structures.

For purposes of illustration only, there are shown in the drawings master and duplicate cards, designated **10** and **14**, respectively, which are of the statistical or tabulating machine type. Such cards are shown as having rectangular apertures **11** and **15**, respectively. A section **12** of developed micro-film, hereinafter termed master or original film section, is mounted in the window of master card **10**. A film section is similarly mounted in window **15** of duplicate card **14**, such film section being designated **16** at the start of the operations schematically depicted in FIG. 10, when it is then in a sensitized but unprinted and undeveloped state. At the end of the operations performed by the machine, after film section **16** has been printed and developed, it is designated **16'**.

Master cards **10** and duplicate cards **14** are identical as to the size and placement of the film-section bearing apertures therein, the apertures being located adjacent one end of the card. It is obvious that to properly duplicate film section **12** upon section **16**, the master and duplicate cards must be superimposed in accurate registry and must be maintained firmly in contact with each other without motion relative to each other during their travel past the exposing or exposure unit of the apparatus. A previous apparatus for the continuous duplication of a plurality of film sections involves the superimposition of the master and duplicate sections on one conveyor, subsequent to which the superimposed film sections are transferred to a second conveyor to carry them past the exposure unit. In another previous apparatus the master and duplicate film sections are not superimposed until they reach the exposure unit. Both such prior apparatuses were thus prone to operating difficulties because of the lack of assurance of accurate registry of the master and duplicate film sections. In accordance with the present invention the master and duplicate film sections are superimposed in a definite-position in a "pocket" on a conveyor well in advance of the exposure unit, so that the film sections may be accurately guided into and will be maintained in registry. The thus superimposed film sections are carried by the same conveyor past the exposure unit, so that there is no possibility of shifting of one of such sections relative to the other during printing operation.

GENERAL DESCRIPTION OF THE APPARATUS AND METHOD

The method of the invention, and the general characteristics of the apparatus of the invention will be generally understood by consideration of FIGS. 1, 4, and 10. A series of master cards bearing film sections **12** are deposited in spaced relationship upon a conveyor, generally designated **17** (FIG. 1), by a master card feeder **19**. A series of duplicate cards **14** each having a sensitized film frame **16** are fed in such spaced relationship by a duplicate card feeder **20** that one card **14** is superimposed upon the master card **10** in each of the pockets on conveyor **17**. Superimposed cards **10** and **14** are carried forward by fingers or dogs on the conveyor which engage the rear edges of the cards, so that the cards are accurately aligned transversely to their direction of travel. During such travel, and also during their continued travel past the exposure unit **22**, the edges of both cards are engaged by guiding means which insure that their side edges lie in alignment. The conveyor **17** carries the cards past exposure unit **22**, the outer surface of which travels in synchronism with the conveyor. See FIG. 4. Unit **22** carries on the periphery thereof, in position to cooperate with film sections **12** and **16**, a plurality of printing stations having selectively operated platens which operate to grip and flatten the film sections against each other and to press them upon a light-transmitting window at each such printing station.

Following the printing operation, which occurs while the film sections are travelling past the exposure unit, the conveyor **17** carries the cards past a master card hopper in which the master cards are stacked, and carries the exposed duplicate cards through a developing zone and thereafter to a duplicate card stacker.

The embodiment of the apparatus shown includes control and safety elements which stop the travel of the conveyor upon the failure of either the master card feed **19** or the duplicate card feeder **20** to feed a card into a pocket on the conveyor. The apparatus also preferably includes means whereby the conveyor is stopped when either of the card stackers **24** or **26** becomes filled. The exposure unit incorporates a selectively operated shutter whereby upon stopping of the conveyor **17** the light source may be shut off from the film sections which lie upon the exposure unit, thereby preventing damage to either the master or duplicate film sections. The apparatus shown is adapted for use with thermally developed film sections. Consequently, the film developer generally designated **25** is in the form of heaters. Such heaters subject the exposed duplicate film sections to an elevated temperature which is insufficient to damage such sections when they pass the heaters at normal speed, but which would injure the film sections exposed to them if the conveyor should stop. The apparatus shown therefore preferably includes further safety means operative upon stoppage of the conveyor to shut off the heaters of the developing unit thereby to prevent damage to the duplicate film sections.

DETAILED DESCRIPTION OF THE APPARATUS

Turning now to a detailed description of the disclosed apparatus in accordance with the invention, such apparatus has a supporting structure generally in the form of a double-decked table having a plurality of upright frame members **29** connected by upper and lower longitudinally and transversely extending frame members, such frame supporting an upper horizontal platform generally designated **31** and a lower horizontal platform generally designated **30**.

Two vertical parallel laterally spaced plate-like members **32** and **34** having outwardly extending spaced lower

flanges or feet **35** are secured to the upper platform **31** by having such flanges bolted to platform **31**. Plates **32** and **34** provide support for a plurality of transverse shafts which mount the main and subsidiary conveyors, a portion of the driving means therefor, as well as card feeders **19** and **20**, exposure unit **22**, etc. The upper portion of the apparatus is enclosed in a sheet metal housing **275**.

The card conveyor

The card conveyor, generally designated **17**, is made up of two similar parallel endless chains **36**, which are spaced apart a distance somewhat exceeding the length of the cards **10** and **14**. Chains **36** are entrained over sprockets **37** secured to the rotatable drum **39** of exposure unit **22**, the chains as will be seen hereinafter, being driven by such sprockets. The upper horizontal runs of chains **36**, and the cards **10** and **14** carried thereby, travel in a direction from the entering end of the apparatus, at the left of FIG. 1, to the exit end thereof which is at the right in such figure. At the entering end of the conveyor, chains **36** run over similar sprockets **46** which are rotatably mounted upon a shaft **48** which extends between and is non-rotatably mounted in members **32** and **34**. Proceeding now in a direction from left to right in FIG. 1, chains **36** run sequentially partially around sprockets **40** mounted on cross shaft **38**, the aforesaid sprockets **37** on drum **39** of the exposure unit, leave the latter sprockets by running downwardly and beneath sprockets **41** mounted on shaft **43**, and travel in a further horizontal run to the sprockets **42** mounted on shaft **53** at the exit end of the conveyor.

After leaving sprockets **42** the chains **36** travel generally downwardly over chain-tightening sprockets **44**, thence over chain supporting sprockets **45**, and back to sprockets **46** at the entering end of the apparatus. Chain-tightening sprockets **44** are mounted upon a horizontal shaft **47** which is journalled in two similarly oppositely disposed bracket members **49**. Members **49** are adjustably secured for movement generally parallel to the runs of chains **36** between sprockets **42** and **44**. Each of members **49** is secured to its respective side plate member **32** and **34** by bolts **50** which extend through longitudinally disposed slots in brackets **49**.

Chains **36** of conveyor **17** are driven in the direction indicated by the arrows in FIG. 1 by a motor **51** supported on lower platform **30** of the frame of the apparatus. Motor **51** drives a speed reducing gear unit **52** having a sprocket **56** on its output shaft. A chain **54** is entrained over sprocket **56** and over sprocket **57** on a countershaft **55** which is journalled in bearings on members **32** and **34**, as shown. As shown most clearly in FIG. 2*a*, a sprocket **59** is secured to the outer end of countershaft **55**, and as shown in FIG. 2*b* a sprocket **61** is secured to the same end of a shaft **62** connected to the drum **39** of the exposure unit **22**. A driving chain **60** is entrained over sprockets **59** and **61**, such chain being tightened as required by a chain-tightener sprocket **65** adjustably mounted on plate member **34** by a bracket **64**.

Each of conveyor chains **36** has a plurality of fingers **66** attached to spaced links thereof, the fingers on opposite chains being laterally aligned to form a plurality of similar card-receiving pockets which somewhat exceed the width of the cards to be received within such pockets. As is apparent in FIGS. 5, 7, and 8, the fingers **66** are generally in the form of brackets of inverted U-shape. The outer vertical portion of each finger is secured to the inner member of such spaced links of each chain, so that the fingers extend oppositely inward toward each other. The other, inner vertically extending portion **67** of each finger **66** is provided with a resilient rubber or rubber-like sleeve, whereby to protect the rear edges of the cards which they abut against damage. As will be apparent in FIGS. 5, 7, and 8, the horizontal portions of fingers **66** extend above and across the card edge guiding track members **165**, **165'**, etc., at one side of the apparatus and **166**, **166'**, etc., on the other side of the apparatus, and, at the exposure unit **22**, above and across the card edge guiding flange **196** thereof.

The card feeders

Master cards **10** are fed one at a time and in the proper horizontally spaced relationship to be deposited in successive pockets on chains **36** of conveyor **17** as the conveyor travels past the zone of discharge of the master cards. Duplicate cards **14** having the apertures therein disposed similarly to those of the master cards (at the right in FIG. 7 and adjacent the reader in FIG. 3) are also sequentially fed one at a time and in the proper spaced relationship so that one duplicate card is deposited upon a previously deposited master card in each pocket on the conveyor. The thus superimposed cards are carried forward by portions **67** of fingers **66** against frictional restraint imposed upon them both by a resilient pressure member and by the card-engaging edge guides, to be described. The cards are accurately aligned transversely of their direction of travel by fingers **66** and endwise by the edge guides. In FIG. 3, the finger which is instantaneously in position first to engage both cards is there designated **66'**.

The master and duplicate cards are fed by card feeders, designated **19** and **20**, respectively, which may be of the type shown in the patent to Rice et al., No. 2,402,774, to which reference is made for specific details of their construction. Since feeders **19** and **20** are of the same construction, parts in feeder **20** which are the same as those in feeder **19** are designated by the same reference characters as in the former feeder but with an added prime. Referring now specifically to feeder **19**, the body of such feeder is supported upon horizontally and inwardly extending ledges **69** on side members **32** and **34**. The feeder includes a vertical hopper made up of confronting channel members **71** of such inner dimensions as to receive freely but accurately a stack of original cards **10** disposed with their long dimensions disposed transversely of the longitudinal extent of the apparatus.

The bottom of the hopper made up of members **71** is formed by a horizontally reciprocable feed table **72** having oppositely extending arms **74** (FIGS. 2*a* and 7) received within horizontal guide ways on the machine frame. Feed table **72** has two spaced forwardly extending card-supporting fingers **75** on its forward edge, and has a rearwardly extending card tray support **76**. The feeder is of such construction that feed table **72** reciprocates horizontally, picking up and forwarding the lowermost card in the stack in its forward movement while continuing to support the stack on the tray **76**.

Feed table **72** of feeder **19** is reciprocated by means of a cam **85** secured to a driven cam shaft **86** (FIGS. 3 and 7) such cam cooperating with a cam follower **87** on a bent lever **81** pivoted on a cross shaft **84** journalled in bearings on plates **32** and **34**. The other end of lever **81** is connected to the feed table **72** by means of a link **79** which is pivotally connected to the upper end of lever **81** by pin **82**, the other end of the link being received between ears **77**, which depend from the bottom of table **72**, and being pivoted to the ears by a pin **80**. The cam follower **87** on lever **81** is maintained in contact with cam **85** by means of a coil tension spring **95** which extends between a fixed cross rod **96** and a pin **97** on lever **81**, as shown. It will be seen that each revolution of shaft **86** causes table **72** to move through one cycle and to deliver one master card from the stack by reason of the engagement of a picker blade **78** secured to the rear of the table **72** with the rear edge of the lowermost card in the stack.

Countershaft **86** which drives the card feeder **19** is driven in the proper timed relationship with conveyor chains **36** by means of a sprocket **89** affixed to shaft **55**, a sprocket **91** affixed to shaft **86**, and a chain **90** entrained over both such sprockets. Chain **90** is kept in the proper tightened condition by means of a tensioning sprocket **92**

mounted on the end of an arm 94 which in turn is mounted for angular adjustment on the cross rod 84.

The duplicate card feeder 20 is located in alignment with but somewhat above and forwardly of master card feeder 19. Feeder 20 is supported upon two horizontal ledges 99 projecting inwardly from plates 32 and 34. Feeder 20, as above explained, may be identical with feeder 19. Further to illustrate the construction of both feeders, the forward end of feeder 20 is vertically sectioned in FIG. 3. As there shown the feeder has a lower forwardly disposed throat block 100' over which the card being delivered moves. The feeder further has a vertically disposed throat knife 101' vertically adjustably mounted upon guide block 102'. When suitably adjusted, throat knife 101' insures the delivery of but one card at a time from the feeder.

The feeder table 72' of card feeder 20 is reciprocated horizontally in synchronism and in phase with reciprocation of table 72 of feeder 19. Table 72' of feeder 20 is driven by a curved lever 104 which has a shape generally similar to lever 81; lever 104 is pivotally mounted at its lower end on a cross shaft 105. Levers 81 and 104 are oscillated in synchronism by the following mechanism: A cam 88, keyed to shaft 86, cooperates with a roller 93 on the upper end of a lever 33 which is journalled at its lower end on shaft 84. See FIG. 7. A link 106 connects the upper end of lever 33 to the midpoint of lever 104. A second spring 95, likewise affixed at its forward end to cross rod 96, is connected at its rear end to lever 33 to maintain its roller 93 in contact with cam 88.

The card forwarding mechanism

Master cards fed by feeder 19 are gripped by a driven pinch roll unit 109 which forwards them in spaced relationship to be deposited singly in successive pockets at the entering end of conveyor 17. Duplicate cards fed from feeder 20 are delivered to a driven pinch unit 110, which is driven at a somewhat slower speed than unit 109, and thence onto a short downwardly inclined driven conveyor belt 132', so that a duplicate card 14 is delivered at the proper time on top of a master card and immediately in front of a pair of fingers on the conveyor 17.

The construction of pinch roll units 109 and 110 and of their associated conveyor belts will be understood upon consideration of FIG. 3. Unit 109 has a first driven bottom roll 111, which may be in the form of a shaft 115 having a series of spaced rubber sheaths or collars spaced therealong. Shaft 115 is driven from countershaft 86 in a manner to be explained. An idle pinion 112 meshes with a gear 116 on shaft 115 and meshes with a similar pinion 119 on a shaft 117. Shaft 117 supports a plurality of small axially spaced pulleys 114, which serve to drive and support the entering ends of two spaced longitudinally extending flat conveyor belts 132.

Pinch roll unit 110 and its associated conveyor belts are of generally the same construction as unit 109 and belts 132, but are positioned above and forwardly of unit 109 and belts 132. The parts of unit 110 and its associated conveyor belts which are similar to those of unit 109 and belts 132 are designated by the same reference characters but with an added prime. Units 109 and 110 are driven in timed relationship by means to be described.

As will be apparent in FIG. 7, there is a first relatively larger V-belt pulley 120 on the left-hand end of shaft 115' of pinch roll unit 110 and a somewhat smaller pulley 124 on the same end of shaft 115 of pinch roll unit 109. A V-belt 121 runs over pulleys 120 and 124 and thence over pulley 122 on the end of driven countershaft 86, whereby the pinch roll units are driven by shaft 86. Belt 121 is maintained under the proper tension by an adjustable idle pulley 125 which is pressed against the belt by an adjustable bracket 126.

Positioned vertically above and in alignment with driven rollers 111 and 111' are spring-pressed idler rollers 127 and 127', respectively. As will be apparent in FIGS. 2*a* and 3, unit 110 includes a shaft 129' mounting rollers 127', shaft 129' being carried on the rear ends of similar parallel arms 130'. The forward ends of arms 130' are pivotally mounted upon frame members 32 and 34 by stub shafts 131'. The rear ends of the arms 130', and the shaft 129' carried thereby, are resiliently urged downwardly by springs 128' the upper ends of which are engaged by vertically adjustable abutment studs 138' screwed into brackets 143', thereby to vary the pressure with which rolls 111' and 127' engage cards 14. The structure of the corresponding portion of pinch roll unit 109 is the same, and need not be further described.

The forward ends of conveyor belts 132 are carried on front pulleys 134 mounted upon a shaft 135 which is adjustable longitudinally of the apparatus by belt tightening bracket means 133 supporting the bearings on opposite ends of shaft 135. The upper runs of belts 132 are disposed horizontally in a plane to receive cards 10 as they issue from feed rolls 111, 127. The upper run of each of belts 132 is supported by a flat plate member 145 over which the belt runs. Each plate member 145 is supported on upstanding side bracket members 144 secured to cross shaft 48 as shown in FIG. 3.

Cards 10 are held firmly pressed against belts 132 by sets of spring-pressed rollers overlying the belts 132. A first set of rollers 136, overlying the entering ends of the belts 132, are mounted on the rear ends of arms 139, the forward ends of such arms being pivotally secured to a cross rod 141. A second set of rollers 137 are secured to the forward ends of arms 140, the rear ends of such arms likewise being pivotally secured to cross rod 141. Coil torsion springs 142 act between arms 139 and 140 to urge the rollers carried thereby toward belts 132. A third set of biased rollers 154 overlie the exit end of belts 132. Rollers 154 are carried on the forward ends of arms 155, the rear ends of such arms being pivotally mounted on shaft 156.

Immediately after the forward end of a card 10 emerges from under rolls 136 the side edges of the cards are received within the entering ends 163 of guide members 161 (FIGS. 2*a* and 3). Such guide members are in the form of elognated horizontal channels fixed with respect to the frame of the apparatus and having confronting grooves which accurately receive the edges of the cards 10 to hold them from any marked vertical or endwise motion as they are moved forwardly through the apparatus. Guide members 161 are supported by the frame of the apparatus by bracket member 162 and spacer block 164 (FIG. 3).

After being delivered from hopper 71 by feed table 72 a card 10 is first caused to travel forwardly by pinch rolls 111, 127, then by such rolls and belts 132 and rollers 136, and finally, after leaving rolls 136 by belts 132 and spring biased rollers 137. In such latter portion of the initial travel of the cards a set of two opposed fingers 66 on conveyor 17 will have presented themselves near the top of sprockets 46 so that such fingers then engage the rear edge of the card and take over in the main the task of forwarding the cards.

The belts 132' associated with pinch rolls 111' are generally similar to the above described belts 132. The upper runs of belts 132', however, incline downwardly in a forward direction from the horizontal plane of the nip of rolls 111', 129' toward the station, at the right in FIG. 3, where a duplicate card is first superimposed upon a master card in a pocket on the conveyor 17. The upper runs of belts 132' are supported by a flat plate 149 which is supported by opposed bracket members 147 secured to cross rod 146. Overlying the upper runs of belts 132' are four sets of spring-biased rollers, the

entering rollers 131', the first intermediate rollers 137', and the exit rollers 154' being similar to the correspondingly designated rollers associated with belts 132, and being similarly mounted and spring-biased toward belt 132'. To insure accurate feeding of duplicate cards 14, there is employed a second intermediate set of spring-biased pressure rollers 151 mounted upon arms 152 on cross rod 156'.

Upon leaving hopper 20 each duplicate card 14 is first fed forward by pinch rolls 111', 127', and shortly thereafter by belts 132' and pressure rollers 136'. Positioned above the entrance end of belts 132' is a guide shoe 150 having an upwardly bent rear or entering end to cause the cards to be progressively deflected downwardly into contact with the upper runs of belts 132'. Belts 132' together with their associated pressure rollers continue the feeding of cards 14 downwardly to the zone at which the cards 14 are superimposed upon cards 10. At such zone there are provided two deflecting guides or shoes 157, adjacent the edge guides at the respective sides of the apparatus. The rear ends of shoes 157 are inclined generally in the direction of, but lie somewhat above, the upper runs of belts 132', and the forward ends of such shoes are generally horizontal and are so positioned as resiliently to urge the cards 14 downwardly. Shoes 157 are mounted on brackets 159 adjustably secured to a cross rod 160. To insure that cards 14 are accurately positioned endwise, there are provided end guide plate members 158 which accurately receive the cards 14 between them. In FIG. 3 a duplicate card, there designated 14', is shown as having been just delivered into the station on the conveyor 17 forwardly of fingers 66' at which the duplicate and master cards are superimposed.

It will be apparent from the above that the card feeders 19 and 20 are driven in synchronism with chains 36 of conveyor 17, and that pinch roll unit 109, and the belts 132 and their associated pressure rollers deliver cards 10 in such spaced sequence that one such card falls into each of the pockets on the conveyor. At the same time that a master card is delivered by feeder 19, the duplicate card which is to be printed by such master card is delivered from feeder 20. Because such duplicate card has a shorter distance to travel from its feeder to the station where the duplicate cards are superimposed upon the master cards than does the master card, pinch roll unit 110 and the associated belts 132' are driven at a slower speed than unit 109 and belts 132.

Shortly after such superpositioning of a duplicate card, and as it is pushed forwardly with its associated master card by fingers 66 the superimposed master and duplicate cards enter card edge guide 165 (at the top of FIG. 2*a*) and 166 (at the bottom of FIG. 2*a*). Edge guide 166 is in effect a prolongation of its associated entering guide 161 except for the fact that the entering end of guide 166 is upwardly open at 173 (FIG. 2*a*) to allow the edges of cards 10 and 14 at such guide to lie in contact with each other. Forwardly of the upwardly open section 173 of guide 166 the groove 153 (FIG. 5) in such guide is closed, the rear end of the upper flange of the guide being upwardly curved at 173 (FIG. 2*a*). It will be apparent that the groove in guide 166 is of such width as to receive the edges of a set of superimposed duplicate and master cards. As will be seen hereinafter, the edges of the cards engaged by guide 166 are adjacent the film sections of the cards which are held firmly together during the printing operation. Guides 165, 165', and 165'', which engage the edges of the cards remote from the film sections mounted therein, have two spaced parallel grooves 180, 181 therein which retain such latter edges of the cards in spaced relationship. Thus, at the zone wherein the cards are superimposed, shown at the right in FIG. 3, the far edge of card 14' is shown as being received upon the upper surface of its guide 161 and about to enter into an upper guiding groove formed by an overlying flange having an upwardly curved rear end 178 (FIG. 2*a*). The construction of guides 165 and 165', except for their longitudinal configurations, are the same as those of exit edge guide portion 165'' shown in FIG. 11.

The edge guide made up of sections 165, 165', and 165'', as shown most clearly in FIGS. 4 and 6, extends forwardly into portions which pass partially around the respective sprocket 40, the drum of the printing or exposure unit 22, and the respective sprocket 41 in that order. Such guide includes the straight horizontal portion 165'' which extends to and beyond the card separator. The card guide engaging the opposite ends of the cards corresponds generally in shape to the guide 165, etc., in that it extends partially around the respective sprocket 40, the drum of the printing unit, and the respective sprocket 41. The latter guide, however, has a portion thereof cooperating with the drum of the printing unit which is discontinuous, that is, such guide has a first or entering portion 166' thereof which terminates at 167 just short of the active exposing zone of the printing unit, and a second exit portion 169 having a card-entering end at 170. During the rotation of the cards with the drum of the printing unit generally from point 167 to beyond point 170 the ends of the cards bearing the film sections are firmly gripped by platens on the printing drum, as will appear hereinafter.

The two opposed card guides 165, 166, etc., are fixedly mounted on the frame of the apparatus by brackets of which two are shown at 168 and 171 in FIG. 4 connected to the side plates 32 and 34 of the frame. In order to support the central portions of the cards to prevent their sagging as they approach and leave the exposure unit, there is provided a longitudinally extending central guide along which the lower surfaces of master cards 10 slide. Guide 172 is supported on brackets 174 (FIG. 2*a*) and 175 (FIG. 4) each of which is in the form of a shallow inverted U extending between plates 32 and 34. Guide 172 has the entering end 176 thereof bent downwardly to permit the smooth entry of the cards thereon. Beyond sprocket 40 guide 172 is continued forwardly and upwardly to a short straight portion at the zone of sprocket 41 and then terminates in a downwardly and forwardly inclined portion 177.

The printing or exposure unit

The printing or exposure unit is shown in detail in FIGS. 2*b*, 4, 5, 7, and 8. As is apparent in FIGS. 2*b*, and 5 the rotatable drum 39 of unit 22 has a smooth circular cylindrical outer surface 179 of such diameter that cards 10 lie upon it as their far edges travel along inner groove 180 of guide 165. The corresponding edges of cards 14, as is apparent in FIG. 5, lie spaced from cards 10 during the travel of the cards with drum 39, that is, they have the same spacing at the drum as they have throughout their joint travel to the drum and after leaving the drum. Such spacing of the far edges of the cards, which allows their ready separation by means to be described, does not interfere with the accurate printing of the film sections of the duplicate cards since the master and duplicate film sections are held firmly in contact during their travel through the printing zone by selectively operable platens as will appear hereinafter.

Drum 39 of the printing unit is provided with an end member 182. A sprocket 37 is secured between the end of drum 39 and the radial flange on end member 182. The above mentioned shaft 62, carrying sprocket 61 by means of which drum 39 is rotated, is journalled in a bearing 185 which is held in housing 184 on frame plate member 34 by a retainer 186. The opposite end of drum 39 is rotatably mounted on means supported by frame side plate 32. Such means includes a circular insert member 189 positioned in an opening 187 near the upper edge of plate 32. Member 189 has a central opening 190 which receives a sleeve 191 projecting axially inwardly of drum 39. A roller bearing 192 is interposed between the inner end of sleeve 191 and flange 194 of end wall 195 of drum 39.

Radially outwardly of end wall **195** drum **39** is provided with a peripheral flange **196** which extends radially outwardly somewhat past the outer surface **179** of the drum. The inner edge of flange **196** is positioned at such distance from the opposed curved guide portion **165'** that the edges of cards **10** and **14** near the film sections thereof are retained against endwise movement by flange **196** during passage of the cards through the active printing zone of unit **22**. As will be apparent in FIGS. 2*b* and 7, the portions of guide members **166'** and **169** immediately confronting flange **196** are in the form of spaced strips having their axially outer edges lying close to the inner edge of flange **196**. Rearwardly of flange **196** and forwardly thereof the guides **166** and **169**, respectively, are in the form of channels.

Drum **39** is provided with a plurality of equally spaced peripherally aligned openings **197** therethrough at such location longitudinally of the drum as to underlie the film sections of the cards. The outer portion of each opening **197** is provided with a seat **199** which receives a transparent pressure plate or window **200** the outer surface of which coincides with the circular cylindrical surface **179**. Plates **200** are retained on the drum by screws **201** (FIG. 2*b*).

As will be apparent in FIG. 4 and 8, drum **39** is provided with a radially inwardly projecting ear **202** adjacent the inner leading corner of each opening **197**. Each ear **202** journals a longitudinally extending stub shaft **204** which is aligned with a second stub shaft **206** rotatably carried in bushing **205** in end wall **195**. Shafts **204** and **206** carried bent levers **207** and **209**, respectively, which are portions of a mounting and operating means for a movable platen made up of pressure plate **210** connected to the outer ends of the levers and a resilient rubber pressure pad **211** secured to the inner face of plate **210**. Plate **210** and pad **211** are suitably curved to hold superimposed cards **10** and **14** uniformly in contact with the associated transparent window **200** when the platen is in closed, operative position.

Somewhat in advance of each opening **197** in drum **39** is an opening **212** (FIGS. 2*b*, 4 and 7) through which the radially extending portions of levers **207** and **209** extend when the platen is closed and into which a portion of the platen is retracted when the platen is open. Each platen is constantly urged toward closed position by a coil tension spring **220** which acts between a cross rod **217** connected to levers **207** and **209** beyond the axis of stub shafts **204** and **206** and a rod **214** fixedly mounted on drum **39**. As shown in FIG. 5, rod **214** extends between end wall **195** of the drum and a radially inwardly projecting ear **215** thereon, being retained by having its enlarged head **216** positioned inwardly of the respective sprocket **37** mounted on the drum. As shown in FIG. 4, rod **217** extends between short angularly directed arms **219** on levers **207** and **209**.

Mechanism is provided whereby, during rotation of drum **39**, the platens are automatically opened before that portion of their travel in which they first receive the sets of superimposed master and duplicate cards, and are automatically allowed to close shortly after the cards have been fully positioned over the respective windows **200**. The mechanism for thus opening the platens includes a cam **221** fixedly mounted in place and cooperating with a cam follower roll **224** operatively connected to each platen. Roll **224** is journaled at the outer end of an arm **222** which, as shown most clearly in FIG. 8, is pinned to an end of stub shaft **204**. Cam **221** is of uniform reduced diameter throughout the major portion of its periphery, including the active printing zone of the drum. The cam has a zone of uniform larger diameter or rise at **232** and ramps **234** and **235**, respectively, leading to and from the rise **232** of the cam. As apparent in FIG. 4, the platens are held closed by their respective springs **220** as their rolls **224** travel around the smaller diametered portion of the cam. As such rolls ride up ramp **234** the platens are progressively opened, being fully opened when rolls **224** overlie rise **232**. The platens are progressively closed as rollers **224** travel down ramp **235**.

The above mentioned cam **221**, which has a hub **230**, is fixedly supported on a fixed axially extending tube **225** having an end member **226** provided with a central pilot or stub shaft **227**. Pilot **227** is journalled in a bushing **229** in a central recess in end member **182** of drum **39**. The end of tube **225** remote from pilot **227** has a portion which is received within a counterbore at the outer end of sleeve **191**, the tube being secured to members **189** and **191** by studs passing through a radially flanged portion of end member **231**.

An elogated light bulb **236** is positioned axially within tube **225**, the bulb being mounted in a socket **237** the base of which is secured to end member **226** of tube **225**. Bulb **236** is supplied with current by a cable **239** which extends through a hole in tube **225**, along the interior of a tube, and to the socket as shown in FIG. 5.

It is desirable that means be provided whereby the light rays and at least a substantial portion of the heat from bulb **236** may be shut off from the film sections of those cards which lie in the active printing zone of drum **39**, as for example during the halting of the rotation of the drum while the bulb remains lighted. For such purpose there is provided a rotatable shutter in the form of a longitudinally extending tube **245** which surrounds the light-emitting portion of bulb **236**. As shown in FIGS. 4, 4*a*, 4*b*, and 5, generally one-half of the active portion of tube **245** is cut away so that light is transmitted from the bulb between edges **246**, **246'** of the shutter to the active printing zone of the drum while tube **245** is positioned as in FIGS. 4 and 4*a*. When, however, tube **245** is turned generally through 180°, as indicated in FIG. 4*b*, light from the bulb is shut off from openings **197** in the drum. Tube **245** has the end thereof at the left in FIG. 5 rotatably mounted in rollers **247** each of which is fixedly mounted in a bracket **249** secured to member **231**. Tube **245** is provided with an end member **250** carrying an axially located stub shaft **251** by means of which tube **245** is selectively operated to lie in either of the positions of FIGS. 4*a* and 4*b* by mechanism to be described.

A pinion **252** is keyed to the outer end of shaft **251** and meshes with a rack **254** on a slide **255** mounted for reciprocation in a horizontal guideway **256** secured to the frame of the apparatus. Slide **255** is retracted, to turn the shutter **245** to closed position, by a solenoid **257** upon energization of such solenoid, and is thrust forwardly to open the shutter by a coil compression spring **267** upon deenergization of the solenoid. The mechanism for thus moving the shutter will be more readily understood upon consideration of FIGS. 4*a* and 4*b*.

Solenoid **257** is provided with an outer U-shaped frame member **259** secured to the frame of the apparatus. The solenoid plunger **260** is secured to a slide member **261** which reciprocates in guideways **262** on the confronting faces of the horizontal parallel legs **264** of frame **259**. A link **265** is pivotally connected between slide member **261** and the rear end of a rod **266** connected to rack slide **255**. Accordingly, when solenoid **257** is energized its plunger, acting through members **261**, **265**, and **266**, pulls rack **254** to the left (FIG. 4*b*) to close shutter **245**. A coil compression spring **267**, which surrounds rod **266** and is interposed between rack slide **255** and a fixed bracket **269**, is of such compressive strength that it is overpowered by the solenoid when the latter is energized but that when the solenoid **257** is deenergized the spring returns the rack **254** to the "shutter open" position of FIG. 4*a*. The terminal position of the shutter may be adjusted within limits by suitably turning an abutment screw **270** which is threadedly mounted in a fixed bracket **271** in the path of slide member **261**.

To avoid undue heating of the parts of the printing unit **22**, and to prolong the operating life of the light bulb **236**, the apparatus is preferably provided with means

for forcing cooling air through the interior of drum 39. As shown most clearly in FIGS. 1 and 2b, a blower 272, which may be of the squirrel cage rotor type, is mounted on one side of the frame of the apparatus, generally somewhat forwardly of the printing unit 22. A curved delivery duct 274 extends from the blower 272 to the left hand end (FIG. 5) of sleeve 191 to which it is connected by a joint generally designated 277 (FIG. 2b). Air delivered under pressure by the blower passes through duct 274 and through suitable openings in the end closure member 250 of tube 245. Such air is then free to pass generally axially of drum 39 both outwardly of tube 225 and inwardly of tube 245 along the light bulb. The latter air passes along the light socket 237, through suitable openings in end member of 226 of tube 225, and then, merging with the air passing outside tube 225, passes to the atmosphere through suitable openings in end member 182 of drum 39. The rate of flow of cooling air through drum 39 may be conveniently regulated by an adjustable damper 276 at the delivery end of the blower.

Card separation

During the travel of superimposed sets of duplicate and master cards past printing unit 22 the edges of the cards remote from the film sections thereof are at all times held separated by the spaced card receiving grooves in guide member 165'. Also, as above explained, the edges of such cards adjacent the film sections are held generally in contact with each other by guide 166 as they enter upon drum 39. In their travel through the printing zone such latter ends of the cards are held by platens 210, such edges of the cards being received within edge guide 169 prior to their release by the platens 210 by the opening of the latter. To insure the correct entry of the edges of the cards adjacent the film sections into guide 169, there is provided a stiff, fixedly mounted peripherally extending wire member 242 which overlies drum 39, as shown in FIGS. 2b and 4. Member 242 progressively approaches the outer surface of the drum in a clockwise direction to guide the cards correctly into the mouth 170 of guide 169.

Upon the opening of platens 210, the driving of the card sets 10, 14 along the curved edge guides around sprocket 41 and thence into the straight terminal portions thereof, schematically shown in FIG. 11 is effected by fingers 66 of conveyor 17. In such portion of their travel the right hand edges (FIG. 11) of cards 10 and 14 lie separated by the central land or rib 278 of guide 165", and the left hand edges of the cards lie generally in contact with each other and within the single longitudinally extending groove in guide 166'. A short distance forwardly of sprocket 41 the apparatus is provided with mechanism for separating the lower, master card 10 from each of the sets of superimposed duplicate and master cards. The separating mechanism is so located as to direct the master cards into the above mentioned master card stacker 24. Such separating mechanism is shown most clearly in FIGS. 2b, 6, and 11.

The card separating mechanism takes the form of a plow-like member 279 fixedly positioned on the frame of the apparatus so as to enter between the leading edges of cards 10 and 14 and to deflect cards 10 downwardly. Member 279 is in the form of a plate partially folded back on itself at a sharpened laterally offset nose portion 281. From such nose portion the plate inclines forwardly along an oblique edge 280 until it reaches an open transversely bent portion having a downwardly extending flange 284. Member 279 is attached at 285 to the forward wall 286 of stacker 24. Downwardly inclined flange portion 284 of member 279 underlies the rear edge of a forwardly and downwardly inclined card deflecting member 291 which is integral with the inner forward wall 290 of stacker 24.

The manner in which member 279 effects separation of a master card 10 from its associated duplicate card 14 will be apparent upon consideration of FIGS. 6 and 11. As shown in FIG. 11 the lower flange of edge guide member 165" is discontinued at a position slightly forward of nose 281 of plow-like member 279, such flange being bent somewhat downwardly and forwardly at its terminus 283. Generally opposite terminus 283, but preferably somewhat forwardly thereof as shown, the lower flange of member 166' is temporarily discontinued, the end of the lower flange at the resulting gap being bent downwardly at 288.

The nose 281 of member 279 lies with its upper surface just below the upper surface of the intermediate flange 278 of guide 165", so that, when a set of cards 10, 14 is pushed forwardly by fingers 66 to cooperate with member 279, nose 281 freely enters the space between cards 10 and 14 at the right in FIG. 11. As the card set continues its forward travel, the lower card 10 is progressively bent at its left hand edge by the inclined edge 280 of member 279, and later by flange 284 of member 279. The gap in the lower flange of guide 166' is of such longitudinal extent as to allow card 10 to be progressively deflected downwardly out of further contact with guide 166'. Thus, by the time the trailing edge of card 10 has passed over portions 283 and 288 of the respective edge guides such card will have been completely stripped from its associated card 14 and will be in position to be received within card stacker 24. During such travel of the card set past member 279, the upper card 14 continues to travel along the upper groove in guide 165". Card 14 is supported to some extent by nose 281 of member 279 so that it tends to remain flat. The gap between the down bent portion 288 of the lower flange of guide 166' and the location where such lower flange resumes is of less extent than the width of card 14, so that a substantial portion of the card at its leading edge will have passed beyond the zone of discontinuity of the lower flange into the location at which the groove 293 in guide 166' is again closed at its bottom. Consequently, card 14 remains stably held at both its side edges as it travels through the card separating zone.

Upon being deflected downwardly over flange portions 283 and 288 of the edge guides, the card 10 enters a card-receiving slot 289 in the rear wall 287 of stacker 24. When the card has been fully freed from the edge guides it falls upon a vertically rectractible platform 292 supported on the top of a vertically reciprocable rod 294. The rod and platform of the stacker are supported by a coil compression spring 295 disposed around the rod and acting between an upper collar 296 secured to the rod and a guide collar 297, secured to platform 30, through which the rod reciprocates. The construction of the stacker is such that as cards 10 are progressively deposited on platform 292 the platform sinks, thereby maintaining the upper card of the stack on the platform a substantially uniform distance below inclined guide member 291.

The film sections of duplicate cards 14, in the disclosed embodiment of the invention, are of the type which are developed by exposure to heat. The apparatus shown includes heater means generally designated 25 which cooperate with cards 14 in their further travel through the apparatus following the separation of the master cards 10. Means 25 include two heater units 304, 304' disposed transversely of conveyer 17 and spaced from each other longitudinally of the conveyor. The housings are in the form of refractory blocks having downwardly open cavities 305, 305' therein, such cavities housing infrared heating elements 306, 306' of the sheathed electrical resistance type.

After treatment by heating means 25, cards 14 are collected in a second stacker 26 which is generally of the same construction as stacker 24 and has its parts similarly designated except for an added prime. Immediately rearwardly of stacker 26 the bottom flanges of edge guides 165" and 166' are bent downwardly at termini similar

to those shown at 283 and 288. The slanting top member 299 of stacker 26 has a rear or entering nose portion which lies slightly above the level of the upper flanges of the edge guides so as progressively to deflect a card 14 as it is pushed forwardly by fingers 66 so that the card enters the stacker 26 through slot 289' in the manner shown in FIG. 6.

Control and safety mechanism

As above indicated, the disclosed embodiment of the apparatus incorporates safety and control mechanisms whereby the conveyor 17 is stopped in the event of the failure of either of the card delivering means 19 and 20 to feed a card forward at the proper time. Each of stackers 24 and 26 is provided with means whereby conveyor 17 is automatically stopped when the stacker is full. Further, the apparatus includes mechanism whereby when the conveyor is thus stopped the light-controlling shutter at the printing unit is automatically closed and the heating elements of developing means 25 are automatically deenergized. Thus, should a misfeeding of the cards occur, the apparatus automatically protects the cards already on the printing unit and also those in the developing zone against damage.

Each of card delivering means 19 and 20 is provided with a detecting means at the delivery end thereof which senses the presence or absence of a card passing from the delivery means. The two such means are identical and are thus designated by the same characters but for added primes in the case of such means associated with card delivery means 20. A "Microswitch" 309 is supported in a fixed bracket 310 at a position immediately forwardly of pinch roll 127. A depending lever 311 is pivoted to the bracket at its upper end by a pivot pin 312 so that the lever may oscillate through a small arc forwardly and rearwardly of the apparatus. The lower end of the lever is provided with a forwardly directed shoe 314 which is so spaced with respect to the path of cards 10 that when a card passes under the shoe it impels lever 311 counterclockwise to operate switch 309 so as to close the circuit therethrough. When no card is passing beneath shoe 314, lever 311 swings through a short arc in a clockwise direction, thereby allowing switch 309 to open.

As shown in FIG. 1, stackers 24 and 26 are each provided with a toggle switch 316, 316', respectively, mounted on the forward wall of the stacker adjacent the bottom end thereof. Such switches, which are spring biased to lie normally in closed position, are provided with inwardly projecting arms 317, 317', respectively, whereby the switches are opened when the respective platform 292, 292' has descended sufficiently under the weight of a stack of cards to depress the switch lever. As will be apparent upon consideration of the control circuit of FIG. 9, switches 309, 309', 316, 316' are connected in series in a holding circuit for a main relay which energizes the motor 51 which drives conveyor 17. Upon the opening of either of switches 309, 309' at a time when it should be closed by the travel of a card therepast, and upon the opening at any time of either of switches 316, 316', the conveyor will stop.

It will be apparent that since the feeding of cards 10 and 14 by their respective pinch rolls 109, 110 is intermittent, it is necessary to maintain the holding circuit closed at those periods in the feeding cycle when cards during normal operation of the apparatus are not delivered beneath the shoes of the levers operating switches 309, 309'. For this purpose there are provided switches 320 and 321 which are connected in parallel (FIG. 9) with the respective switch 309, 309'. Switch 321 is shown in FIGS. 1 and 3, and switches 320 and 321 are shown in FIG. 7. Both such switches are supported on a bracket 319 affixed to frame plate 34, and are operated by cams 322 and 324 affixed to shaft 86. Shaft 86, as we have seen, carries cams 85 and 88 by means of which card delivery means 19 and 20 are operated.

The mechanism for operating each of switches 320 and 321 from its respective cam mechanisms are similar, that for switch 321 being shown in FIG. 3. Switch 321, which is normally closed, has a plunger 325 which is urged outwardly by spring means, not shown. Pivotally mounted by pin 327 on a bracket 329 affixed to the switch is a rocker member. The rocker member has a shorter arm 326 the free end of which cooperates with the outer end of plunger 325, and a longer arm 330 carrying a roller 331 which rides along the surface of cam 324. Such cam has a first, smaller diameter cylindrical surface, 332 which extends over the main extent of the cam, and a relatively short rise or larger diameter portion 334. The configuration and arrangement of the parts are such that, when roller 331 overlies cam surface 332 switch 321 is closed, and that, when such roller lies upon cam surface 334 the switch is open. The rise 334 on cam 324 and the rise on the similar cam 322 for operating switch 320 are of such peripheral extent and are so located with respect to the card feeding cams 85 and 88 on driven shaft 86 that switches 320 and 321 are opened immediately after the switches 309 and 309' are closed by the passage of cards 10 and 14, respectively, and that switches 320 and 321 are closed at least shortly before switches 309 and 309' are again opened. Consequently, that portion of the holding circuit 354 shown at the right in FIG. 9 remains closed as long as cards are fed correctly by means 109 and 110 during operation of the machine.

The control circuit

The control circuit for the apparatus and the various parts associated therewith are shown diagrammatically in FIG. 9. Electrical current for driving the conveyor, energizing the light bulb and heaters, developing the film sections, etc., is supplied by the current source designated L_1, L_2. In the disclosed embodiment source L_1, L_2 supplies alternating current. The control circuit includes a starting circuit, whereby the first or main relay A is initially placed in closed, operating position. The starting circuit has a manually operated switch 335 connected to lead L_2, a wire 336 leading from the switch 335 to a starting switch 337, a solenoid coil 340 for relay A, and a wire 341 connecting the other end of the solenoid coil to lead L_1. Upon the closing of switch 337, solenoid coil 340 is energized, thereby to pull plunger 342 of relay A upwardly to close the main circuits through the relay. This also causes contactor 356 to close the circuit between contacts 355 in the holding circuit 350 so that, if all other switches in the holding circuit are closed, solenoid 340 remains energized upon the release of starting switch 337. Holding circuit 350 includes a manually operable "stop switch" 351, the stacker stop switches 316, 316', and the above described sets of switches 309, 320 and 309', 321, all connected in series by the wires 352 and 354, as shown. Ordinarily it is preferred to provide a wire and a further switch selectively bridging the last named switches, whereby the apparatus may be test operated without cards 10 and 14. Such wire and further switch are omitted from FIG. 9 for the sake of simplification. A wire 346 connects the holding circuit contacts of relay A with lead L_2. It will be seen that once the holding circuit 350 has been energized it continues to hold plunger 342 of relay A upwardly until the holding circuit is opened by any one or more of switches 351, 316, 316', and the two sets of card detecting switches. Should the holding circuit be opened by one or more of such switches, solenoid 340 will be deenergized and the main circuits through relay A will be denergized. In such position of relay A, shutter-closing solenoid 257 is energized through a circuit including wires 346 and 347, contacts 344 and contactor 345, and wire 349.

In the upper position of contactor 345, which it occupies when solenoid 340 is energized, the contactor com-

pletes the circuit to the driving motor 51 for conveyor 17 through wires 346, 347, contacts 357, contactor 345, wire 359, heater coil 360 for motor 51, and wire 361. At the same time the heaters 306, 306' are energized through manually operated switch 362, assuming the latter is closed, and an adjustable voltage supply means shown as an autotransformer of "Powerstat" 364.

The circuit also includes means for selectively energizing the light bulb 236 at the printing unit 22 and a motor 377 for the cooling blower 272. The circuit for energizing the light bulb includes a wire 365 from lead L_2, a manually operated switch 366, a transformer 367, and a return wire 369 to lead L_1. The blower 377 is supplied from the same circuit which energizes bulb 236, and is initially under the control of the switch 366 for the latter. A wire 370 extends from wire 365 through a manually operated switch 371 to the solenoid 372 of a relay B. Relay B is of such construction that its plunger 374 is normally retained in the elevated position shown in FIG. 9 unless solenoid 372 is energized. Upon the initial energization of solenoid 372 through wires 369, 370, a holding circuit for relay B is established through the closed manually operated switch 380, wire 379, contacts 381, contactor 382 and wire 384. Consequently, once the blower motor 377 has been started it remains in operation, regardless of the deenergization of light bulb 236, until switch 380 is opened. Blower motor 377 is energized, when plunger 374 of relay B is in its lower position, through a circuit including switch 380, wire 379, contacts 375, and contactor 376.

The operation of the apparatus will be readily understood from the foregoing description and may be briefly summarized as follows: Assume that the hopper 71 is provided with a number of master cards to be reproduced, and that the hopper of card delivery means 20 is supplied with at least an equal number of unprinted duplicate cards. Switches 355, 362, 366, and 371 are now closed, in order to ready the starting circuit, energize the heaters at the developer, light the printing bulb 236, and start the blower motor. The contactor of starting switch 337 is now depressed momentarily until the holding circuit 350 takes over the function of energizing solenoid 340 to hold relay A in closed position. The conveyor motor 51 is thus energized and the shutter 245 at the printing unit is opened.

Master cards 10 and duplicate cards 14 are then fed forwardly by means 19, 109 and 20, 110, respectively. One card 10 is deposited in each pocket on conveyor 17 forwardly of each set of fingers 66 and, when such cards have reached the zone at the right in FIG. 3 a card 14 is superimposed on its associated card 10 in each pocket. Each such card set 10, 14, guided with the cards 10 and 14 thereof received within edge guides 165, 165', and 166, 166', respectively, travel up and partially around sprockets 40, being pushed along such path of travel by the sets of fingers 66 on conveyor 17. The drum 39 of printing unit 22 is driven in timed relationship with respect to conveyor 17 that the sets of cards enter into cooperation with the drum, in the zone in which platens 210 are open, so that the film sections of the cards accurately overlie the windows 200 in the drum. During such portion of the travel of the card sets, as well as the further portion of such travel up, over, and down around the drum, the rear edges of the cards remain engaged by the fingers 66 of the conveyor.

At a zone in the travel of the drum 39 in which the windows 200 have not quite reached the radial plane of the edge 246 of the shutter the platens 210 are closed. The printing operation begins when light from bulb 236 passes through windows 200. The film sections remain exposed to light from bulb 236 until the windows 200 have travelled beyond the radial plane of edge 246' of shutter 245. Shortly after the drum has travelled beyond this position, the platens 210 are opened so as to clear the cards and to allow their removal from drum 39 by the conveyor 17 as it passes downwardly from the drum and around the sprockets 41.

The card sets continue to be impelled forwardly by fingers 66 of the conveyor, which then impels them through the card separating zone where the master cards are stripped from the duplicate cards and collected in stacker 24. Duplicate cards 14 continue their forward travel, being carried forward by conveyor 17 through the developing zone 25 and finally into the stacker 26.

The conveyor motor 51, and the film-developing heaters 306, 306', may be stopped at any time by depressing the "stop switch" 351. Such elements are also deenergized whenever either of stackers 24 and 26 becomes full and, as above explained, whenever a card 10 or 14 is not correctly delivered to the conveyor 17. Upon the stopping of the conveyor through deenergization of motor 51, light from bulb 236 is automatically cut off from the film sections on drums 39 by the closing of shutter 245.

Although only one embodiment of the present invention has been illustrated in the accompanying drawings and described in the foregoing specification, it is to be understood that said invention is not limited to said embodiment or to the particular type of insert and card disclosed. Thus, for example, the film sections of the duplicate cards may be of the type which is chemically developed, in which case the developing unit of the apparatus will be changed accordingly. Various other changes may be made in the apparatus of the invention, particularly in the design and arrangement of the parts illustrated without departing from the spirit and scope of the invention as will now be clear to those skilled in the art.

What is claimed is:

1. A photoprinting machine for printing a set of duplicate card-like members having at least one sensitized portion from a set of original card-like members having a similarly located original printed portion, comprising a driven conveyor having a series of member-receiving pockets thereon, means for driving the conveyor, means for depositing a first member from one set in each pocket, means for depositing a second member from the other set in each pocket in superimposed relation to the first member, means for guiding the edges of said superimposed members as they travel with the conveyor to retain them generally in the plane of the conveyor and against endwise movement, and a photoprinter having a light source and arranged to be traversed by the conveyor so that the members in the pockets of the conveyor are sequentially exposed to the light source to print the duplicate members.

2. A photoprinting machine for printing a set of duplicate card-like members having at least one sensitized portion from a set of original card-like members having a similarly located original printed portion, comprising an endless driven conveyor having a series of member-receiving pockets thereon, means for driving the conveyor, means for depositing a first member from one set in each pocket, means for depositing a second member from the other set in each pocket in superimposed relation to the first member, means for guiding the edges of said superimposed members as they travel with the conveyor to retain them generally in the plane of the conveyor and against endwise movement, a photoprinter having a light source and arranged to be traversed by the conveyor so that the members in the pockets of the conveyor are sequentially exposed to the light source to print the duplicate members, and means beyond the photoprinter for separating the superimposed members and removing the original members from the conveyor.

3. A photoprinting machine for printing a set of duplicate card-like members having at least one sensitized portion from a set of original card-like members having a similarly located original printed portion, comprising an endless driven conveyor having a series of member-receiving pockets thereon, means for driving the conveyor,

means for depositing a first member from one set in each pocket, means for depositing a second member from the other set in each pocket in superimposed relation to the first member, means for guiding the edges of said superimposed members as they travel with the conveyor to retain them generally in the plane of the conveyor and against endwise movement, a photoprinter having a light source and arranged to be traversed by the conveyor so that the members in the pockets of the conveyor are sequentially exposed to the light source to print the duplicate members, means beyond the photoprinter for separating the superimposed members and removing the original members from the conveyor, and means to develop the exposed duplicate members while they are still in the pockets of the conveyor.

4. A photoprinting machine for printing a set of duplicate card-like members having at least one sensitized portion from a set of original card-like members having a similarly located original printed portion, comprising an endless driven conveyor having a series of upwardly open member-receiving pockets thereon, means for driving the conveyor, means for depositing a first member from one set in each pocket, means for depositing a second member from the other set in each pocket in superimposed relation to the first member, means for guiding the edges of said superimposed members as they travel with the conveyor to retain them generally in the plane of the conveyor and against endwise movement, and a photoprinter having a light source and arranged in the path of the conveyor so that the members in the pockets of the conveyor travel over the photoprinter and are sequentially exposed to the light source to print the duplicate members.

5. A photoprinting machine as claimed in claim 4, comprising means to develop the exposed duplicate members while they are still in the pockets of the conveyor.

6. A photoprinting machine as claimed in claim 5, comprising means positioned in advance of the developing means to separate the superimposed members and to remove the original members from the conveyor.

7. A photoprinting machine for forming a set of duplicate cards having a sensitized portion from a set of master cards having a similarly located original printed portion, comprising an endless driven conveyor having a series of upwardly open card-receiving pockets thereon, means for driving the conveyor, means for depositing a first card from one set in each pocket, means for depositing a second card from the other set in each pocket in superimposed relation to the first card, means for guiding the edges of said superimposed members as they travel with the conveyor to retain them generally in the plane of the conveyor and against endwise movement, a photoprinter having a light source and arranged in the path of the conveyor so that the cards in the pockets of the conveyor travel past the photoprinter and are sequentially exposed to the light source to print the duplicate cards, means beyond the photoprinter for separating the superimposed cards and removing the master cards from the conveyor, and means to develop the exposed duplicate cards while still in the pockets on the conveyor.

8. A photoprinting machine for forming a set of duplicate cards having a sensitized portion from a set of master cards having a similarly located original printed portion, comprising an endless driven conveyor having a series of upwardly open card-receiving pockets thereon, means for driving the conveyor, means for depositing a first card from one set in each pocket, means for depositing a second card from the other set in each pocket in superimposed relation to the first card, means for guiding the edges of said superimposed members as they travel with the conveyor to retain them generally in the plane of the conveyor and against endwise movement, a photoprinter having a light source and so arranged in the path of the conveyor that the cards in the pockets of the conveyor travel over the photoprinter and are sequentially exposed to the light source to print the duplicate cards, means beyond the photoprinter for separating the superimposed cards and removing the master cards from the conveyor, means to develop the exposed duplicate cards while still in the pockets on the conveyor, and means to discharge the developed duplicate cards from the conveyor.

9. A photoprinting machine for printing a set of duplicate card-like members having at least one sensitized portion from a set of original card-like members having a similarly located original printed portion, comprising an endless driven conveyor having two drivingly connected laterally spaced similar chains having a series of fingers equally spaced longitudinally of the chains for engaging the trailing edges of the members, means for driving the conveyor, means for depositing the first member from one set onto the conveyor in advance of each set of fingers, means for depositing the second member from the other set in advance of each set of fingers in superimposed relation to the first member on the conveyor, means for engaging the opposite side edges of the cards as they travel with the conveyor for retaining them generally in the plane of the conveyor and against substantial endwise movement, and a photoprinter having a light source and arranged to be traversed by the conveyor so that the superimposed members on the conveyor are sequentially exposed to the light source to print the duplicate members.

10. A photoprinting machine for printing a set of duplicate card-like members having at least one sensitized portion from a set of original card-like members having a similarly located original printed portion, comprising an endless driven conveyor having two drivingly connected laterally spaced similar chains for engaging the trailing edges of the members adjacent the side edges of the members, means for driving the conveyor, means for depositing the first member from one set onto the conveyor in advance of each set of fingers, means for depositing the second member from the other set in advance of each set of fingers in superimposed relation to the first member on the conveyor, means extending longitudinally of the respective chains and laterally inwardly of them for engaging the opposite side edges of the cards as they travel with the conveyor for retaining them generally in the plane of the conveyor and against substantial endwise movement, and a photoprinter having a light source and arranged to be traversed by the conveyor so that the superimposed members on the conveyor are sequentially exposed to the light source to print the duplicate members.

11. A photoprinting machine for forming a set of duplicate cards having a sensitized film portion at one zone thereof from a set of master cards having a similarly located original printed film portion, comprising an endless driven conveyor having a series of card-receiving pockets thereon, means for driving the conveyor, means for depositing a first card from one set in each pocket, means for depositing a second card from the other set in each pocket in superimposed relation to the first card, means for guiding the cards as they travel with the conveyor to retain them against substantial endwise movement, means for holding in spaced relationship the confronting edges of the original and duplicate cards of one set remote from the film portions, a photoprinter having a light source and arranged to be traversed by the conveyor so that the cards in the pockets of the conveyor are sequentially exposed to the light source to print the duplicate cards, means to press the film portion of the duplicate cards and the film portion of the master cards together in their travel past the photoprinter, and means thereafter to separate the master and duplicate cards of each set, said last-named means including a member which is first introduced between the cards at the zone of their separated edges.

12. A photoprinting machine for forming a set of duplicate cards having a sensitized film portion at one zone

thereof from a set of master cards having a similarly located original printed film portion, comprising an endless driven conveyor having a series of upwardly open card-receiving pockets thereon, means for driving the conveyor, means for depositing a master card in each pocket, means for depositing a duplicate card on top of the thus deposited master card, means for guiding the cards as they travel with the conveyor to retain them against substantial endwise movement, a photoprinter having a light source and arranged to be traversed by the conveyor so that the cards in the pockets of the conveyor travel over the photoprinter and are sequentially exposed to the light source to print the duplicate cards, means to press the sensitized film portion of the duplicate cards and the printed film portion of the master cards together and such portions of the master cards against the photoprinter in their travel past the photoprinter, and means thereafter to separate the master and duplicate cards of each set.

13. A photoprinting machine for printing a set of duplicate card-like members having at least one sensitized film portion from a set of original card-like members each having a similarly located original printed film portion, comprising an endless driven conveyor having a series of member-receiving prockets thereon, means for driving the conveyor, means for depositing a first member from one set in each pocket, means for depositing a second member from the other set in each pocket in superimposed relation to the thus deposited first member, means for guiding the edges of said superimposed members as they travel with the conveyor to retain them generally in the plane of the conveyor and against endwise movement, and a photoprinter having a light source and arranged to be traversed by the conveyor, the photoprinter having a plurality of spaced card-exposing zones movable in the direction of travel of the conveyor in timed relationship therewith so that the members in the pockets of the conveyor are sequentially exposed to the light source to print the duplicate members.

14. A photoprinting machine for printing a set of duplicate card-like members having at least one sensitized film portion from a set of original card-like members each having a similarly located original printed film portion, comprising an endless driven conveyor having a series of upwardly open member-receiving pockets thereon, means for driving the conveyor, means for depositing a first member from one set in each pocket, means for depositing a second member from the other set in each pocket in superimposed relation to the thus deposited first member, means for guiding the edges of said superimposed members as they travel with the conveyor to retain them generally in the plane of the conveyor and against endwise movement, and a photoprinter having a light source and so arranged that the portion of the conveyor carrying the superimposed members passes over the photoprinter, the photoprinter having a plurality of card-exposing zones spaced along the direction of travel of the conveyor and movable in the direction of travel of the conveyor in timed relationship therewith so that the members in the pockets of the conveyor are sequentially exposed to the light source to print the duplicate members.

15. A photoprinting machine for printing a set of duplicate card-like members having at least one sensitized film portion from a set of original card-like members each having a similarly located original printed film portion, comprising an endless driven conveyor having a series of member-receiving pockets thereon, means for driving the conveyor, means for depositing a first member from one set in each pocket, means for depositing a second member from the other set in each pocket in superimposed relation to the thus deposited first member, means for guiding the edges of said superimposed members as they travel with the conveyor to retain them generally in the plane of the conveyor and against endwise movement, and a photoprinter having a light source and arranged to be traversed by the conveyor, the photoprinter having a plurality of card-exposing zones spaced longitudinally of the conveyor and movable in the direction of travel of the conveyor in timed relationship therewith so that the members in the pockets of the conveyor are sequentially exposed to the light source to print the duplicate members, and means at the photoprinter for pressing the film portions of the members together and the member adjacent the photoprinter against the surface of the latter at the card-exposing zones.

16. A photoprinting machine as claimed in claim 15 wherein the conveyor has spaced parallel chains, the chains have a plurality of equally longitudinally spaced sets of card engaging fingers thereon, and the chains of the conveyor extend along opposite sides of the active printing area of the photoprinter and have a synchronized driving relationship with respect to the movable surface of the photoprinter.

17. A photoprinting machine as claimed in claim 16 wherein the photoprinter has a circular cylindrical drum and has conveyor chain-engaging sprockets on the ends thereof which are generally of the same diameter as the diameter of the drum.

18. A photoprinting machine as claimed in claim 17 wherein the conveyor has a first substantially straight portion which includes the zone at which the members are superimposed, a second part-circular zone coaxial of the drum of the photoprinter, and a third substantially straight portion beyond the photoprinter.

19. A photoprinting machine as claimed in claim 18 wherein the first and third portions of the conveyor are generally aligned and both lie well below the axis of the drum, and comprising sprockets lying close to the drum for diverting the conveyor chains from the first portion of the conveyor to the second portion thereof, and from the second portion of the conveyor to the third portion thereof.

20. A photoprinter comprising a rotatable circular cylindrical drum, means to rotate the drum at a substantially fixed speed about its axis, a light source within the drum, shutter means cooperating with the light source so as normally to expose only a zone, which is fixed in space, of the interior of the drum to said light source, a plurality of printing stations on the drum and spaced peripherally around the drum, each station having a transparent window in the wall of the drum and receiving light from the light source as the station travels through the exposure zone and a platen means arranged to cooperate with the window, and means to open the platens to positions removed from said windows when they leave the exposure zone and to close them to positions overlying said windows as they approach the exposure zone during rotation of the drum.

21. A photoprinter comprising in combination a rotatable circular cylindrical drum, means to rotate the drum about its axis, a light source within the drum, shutter means cooperating with the light source so as normally to expose only a zone, which is fixed in space, of the interior of the drum to said light source, a plurality of printing stations on the drum and spaced peripherally around the drum, each station including a transparent window in the wall of the drum and receiving light from the light source as the station travels through the exposure zone, and a platen means automatically moved into a closed position overlying said window when the printing station travels into the exposure zone and into an open position removed from said window when the printing station travels out of the exposure zone, and a conveyor driven in timed relationship with the drum for presenting a set of superimposed master and duplicate members to be printed to each of the printing stations in advance of their entrance into the exposure zone and before the platen means therefor has closed.

22. A photoprinting machine as claimed in claim 21

wherein said platen means comprise means to engage only a portion of the surface of said duplicate member when in a closed position whereby only portions of said duplicate and master members are pressed into contact with each other and with the transparent window.

23. A photoprinting machine comprising in combination a photoprinter having a rotatable circular cylindrical drum, means to rotate the drum at a substantially fixed speed about its axis, a light source within the drum, shutter means cooperating with the light source so as normally to expose only a zone, which is fixed in space, of the interior of the drum to said light source, a plurality of printing stations on the drum and spaced peripherally around the drum, each station having a transparent window in the wall of the drum and receiving light from the light source as the station travels through the exposure zone and a platen means arranged to cooperate with the window, and means to open the platens to positions removed from said windows when they leave the exposure zone and to close them so that said platens overlie said windows as they approach the exposure zone during rotation of the drum, and a conveyor driven in timed relation with the drum, said conveyor having a first portion for presenting sets of superimposed master members and duplicate members to be printed therefrom to the printing stations on the drum in position to be engaged by the platens as they approach the exposure zone and a second portion for removing such sets of master and duplicate members from the drum after the duplicate members have been printed.

24. A photoprinting machine comprising in combination a photoprinter having a rotatable circular cylindrical drum, means to rotate the drum at a substantially fixed speed about its axis, a light source within the drum, shutter means cooperating with the light source so as normally to expose only a zone, which is fixed in space, of the interior of the drum to said light source, a plurality of printing stations on the drum and spaced peripherally around the drum, each station having a transparent window in the wall of the drum and receiving light from the light source as the station travels through the exposure zone and a platen means arranged to cooperate with the window, and means to open the platens to positions removed from said windows when they leave the exposure zone and to close them so that said platens overlie said windows as they approach the exposure zone during rotation of the drum, and a conveyor driven in timed relation with the drum, said conveyor having a first portion for presenting sets of superimposed master members and duplicate members to be printed therefrom to the printing stations on the drum in position to be engaged by the platens as they approach the exposure zone, a second portion cooperating with the master and duplicate members as they travel past the exposure zone of the photoprinter, and a third portion for removing such sets of master and duplicate members from the drum after the duplicate members have been printed.

25. A photoprinting machine as claimed in claim 24 wherein the conveyor comprises two laterally spaced chains having parallel runs each of which includes a said first, second, and third portion, each chain has a series of equally spaced projecting members for engaging the rear edges of superimposed master and duplicate cards, and wherein the machine includes members for engaging and guiding the opposite edges of the cards in their travel through the first, second, and third portions of the conveyor.

26. A photoprinting machine for printing a set of duplicate card-like members having at least one sensitized portion from a set of original card-like members having a similarly located original printed portion, comprising a driven conveyor having a series of member-receiving pockets thereon, means for driving the conveyor, means for depositing a first member from one set in each conveyor pocket, means for depositing a second member from the other set in each conveyor pocket in superimposed relation to the first member, means to drive each of said depositing means in synchronism with the conveyor, detecting means at each of said depositing means to be actuated by the failure of the depositing of a card by said depositing means, means associated with said conveyor for guiding the edges of said superimposed cards as they travel with said conveyor to retain them generally in the plane of the conveyor and against endwise movement, a photoprinter having a light source and arranged to be traversed by the conveyor, the photoprinter having a plurality of card-exposing zones spaced longitudinally of the conveyor and movable in the direction of travel of the conveyor in timed relation therewith so that the members in the pockets of the conveyor are sequentially exposed to the light source to print the duplicate members, said light source being fixed and surrounded by a movable shutter means whereby when the shutter is open said duplicate members are exposed to said light source and when the shutter is closed said duplicate members are not exposed to said light source, means to normally retain said shutter in open position and responsive to the actuation of either of said detecting means to close said shutter.

27. A photoprinting machine as claimed in claim 26 wherein the sensitized portions of the duplicate members are thermally developable, comprising means to separate the original members from the duplicate members on the conveyor, means to heat the duplicate members to develop them after such separation, and means responsive to the actuation of said detecting means to deenergize the heating means.

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