United States Patent [19]

Bodendoerfer

[11] **3,739,968**

[45] **June 19, 1973**

[54] **REGISTRATION CONTROL TIMING SWITCH FOR WEB-PROCESSING MACHINE**

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[73] Assignee: **Paper Machinery Corporation,** Milwaukee, Wis.

[22] Filed: **Dec. 29, 1971**

[21] Appl. No.: **213,502**

[52] **U.S. Cl.** **226/30,** 83/74

[51] **Int. Cl.** **B65h 23/18**

[58] **Field of Search** 226/27, 30, 38; 83/74

[56] **References Cited**

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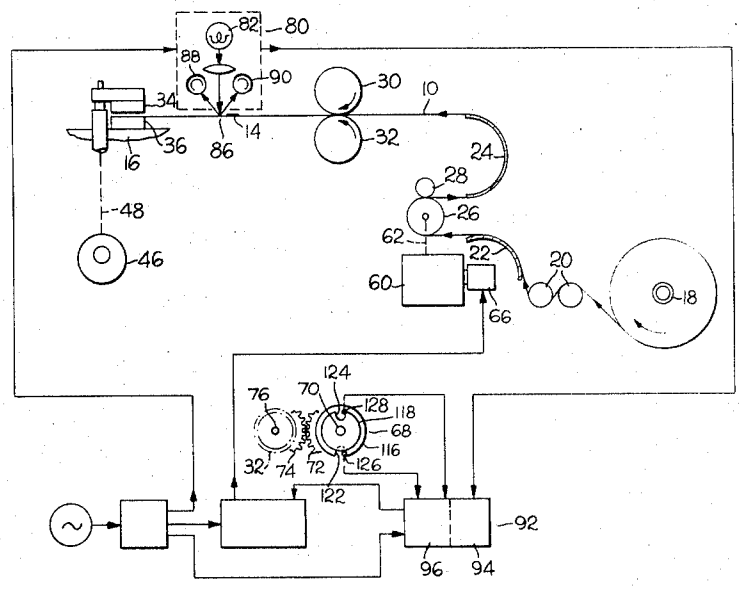
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Primary Examiner—Richard A. Schacher
Assistant Examiner—Gene A. Church
Attorney—James E. Nilles

[57] **ABSTRACT**

Web-cutting apparatus wherein an individual cutting zone on a web must be properly positioned (i.e., in register) relative to a cutting blade at a predetermined time to insure a proper cut requires control means, including a timing or selector switch, for determining if registry exists and for making appropriate changes in web speed if it does not. The timing or selector switch comprises a rotatable shaft synchronized with operation of the cutting blade. A pair of ferrous metal discs are mounted on and rotatable with the shaft. Each disc has a notch in its periphery, and a pair of magnetic pickup devices, one for each disc, are mounted in fixed positions relative to their respective discs. Each pickup device provides an electrical pulse upon passage of the notch in its associated disc as the latter rotates. The interval between the pulses produced by the two pickups for each rotation of the shaft serves as the desired time interval. The duration of the time interval can be varied by changing the angular distance between the pickup devices by moving either one or both to a different position. The time interval itself can be shifted by changing the positions of both pickup devices without changing the angular distance between them to effect advancement or retardation of the web to achieve registry.

7 Claims, 10 Drawing Figures



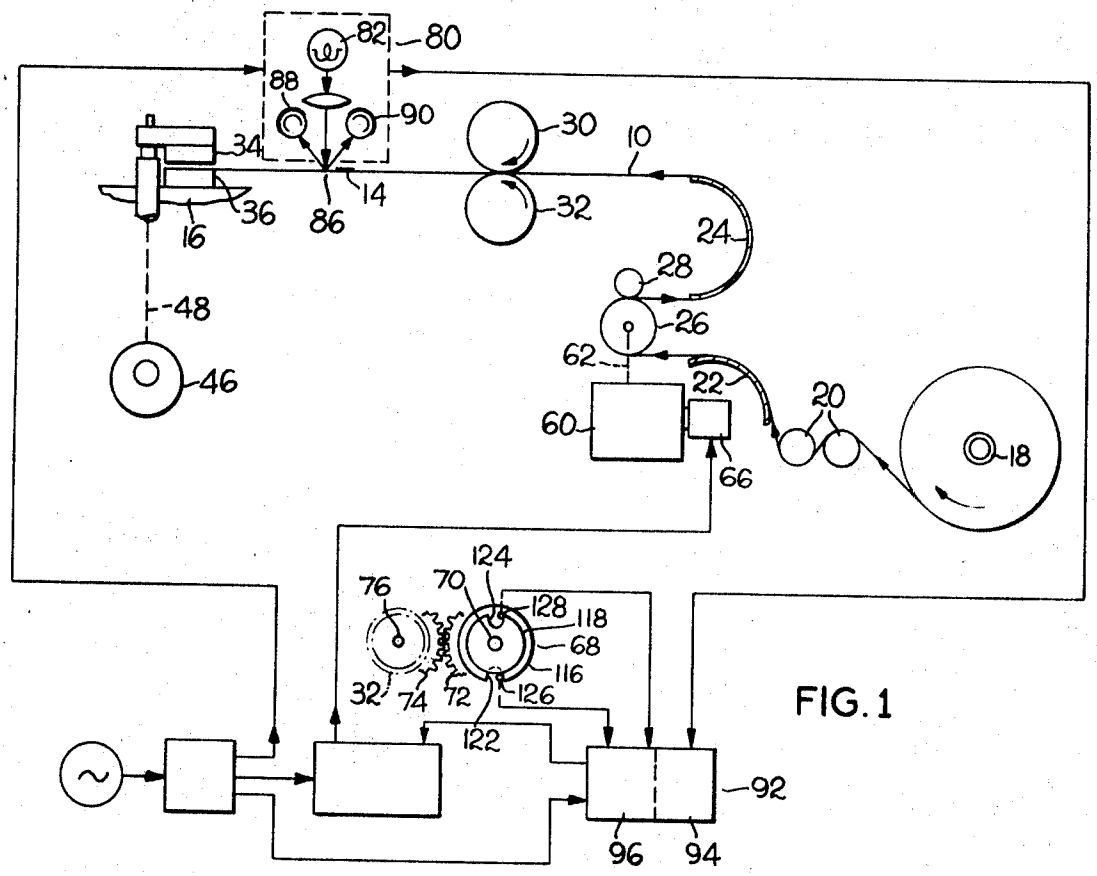

82
80
88
90
34
30
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36
86
14
32
16
24
28
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26
62
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20
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32
74
72
126
122
92
96
94

FIG. 1

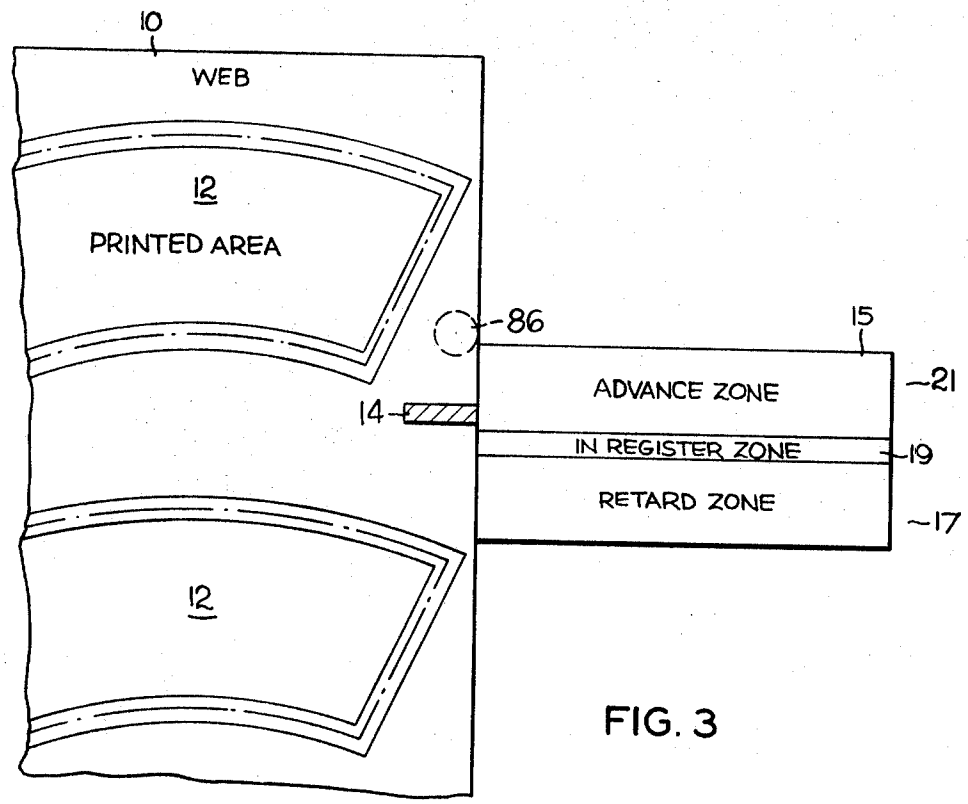

10
WEB
12
PRINTED AREA
86
15
ADVANCE ZONE
21
14
IN REGISTER ZONE
19
RETARD ZONE
17
12

FIG. 3

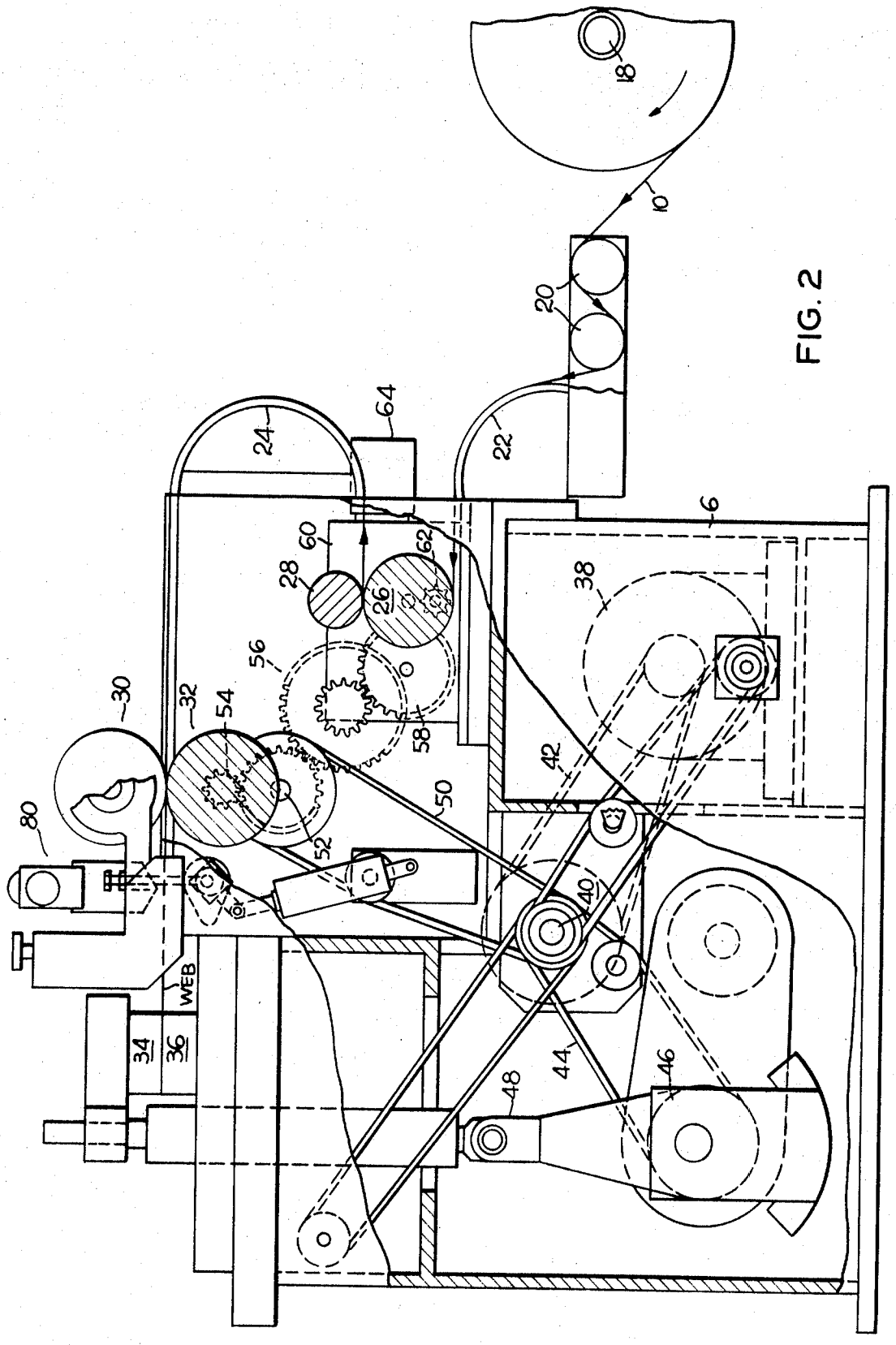

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64
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60
62
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38
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WEB
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48

FIG. 2

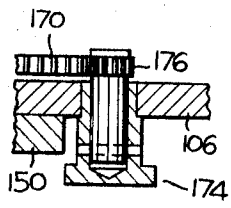


FIG. 9

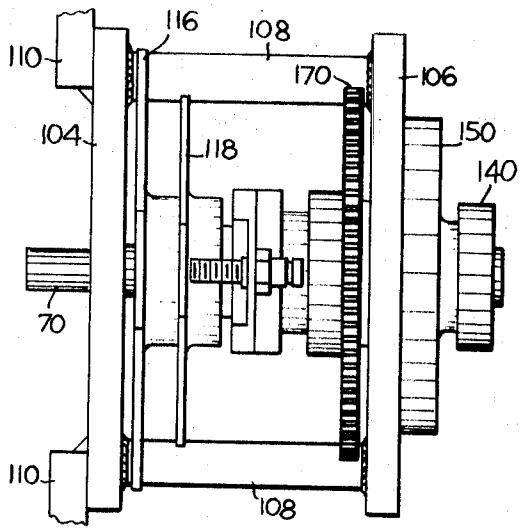


FIG. 7

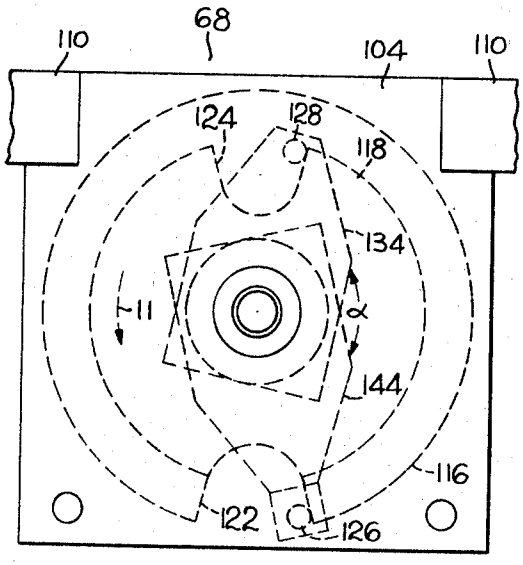


FIG. 5

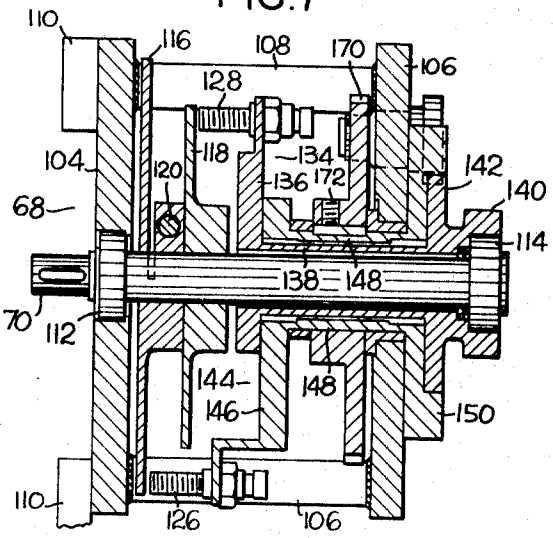


FIG. 6

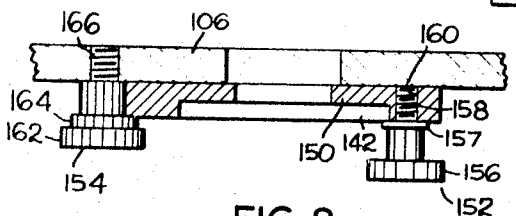


FIG. 8

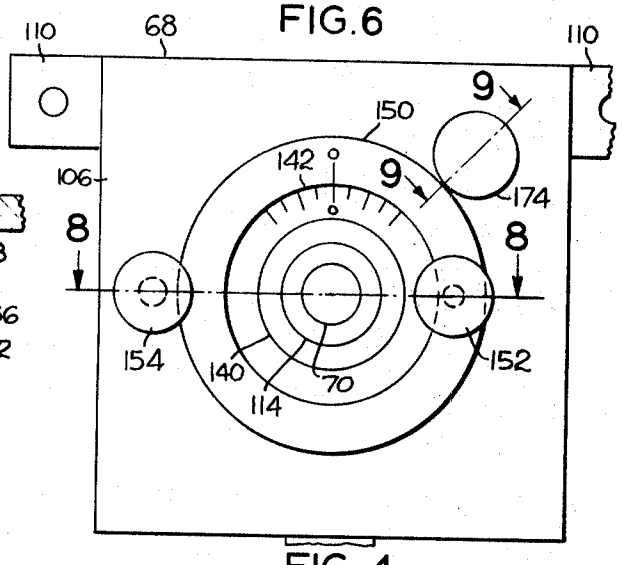


FIG. 4

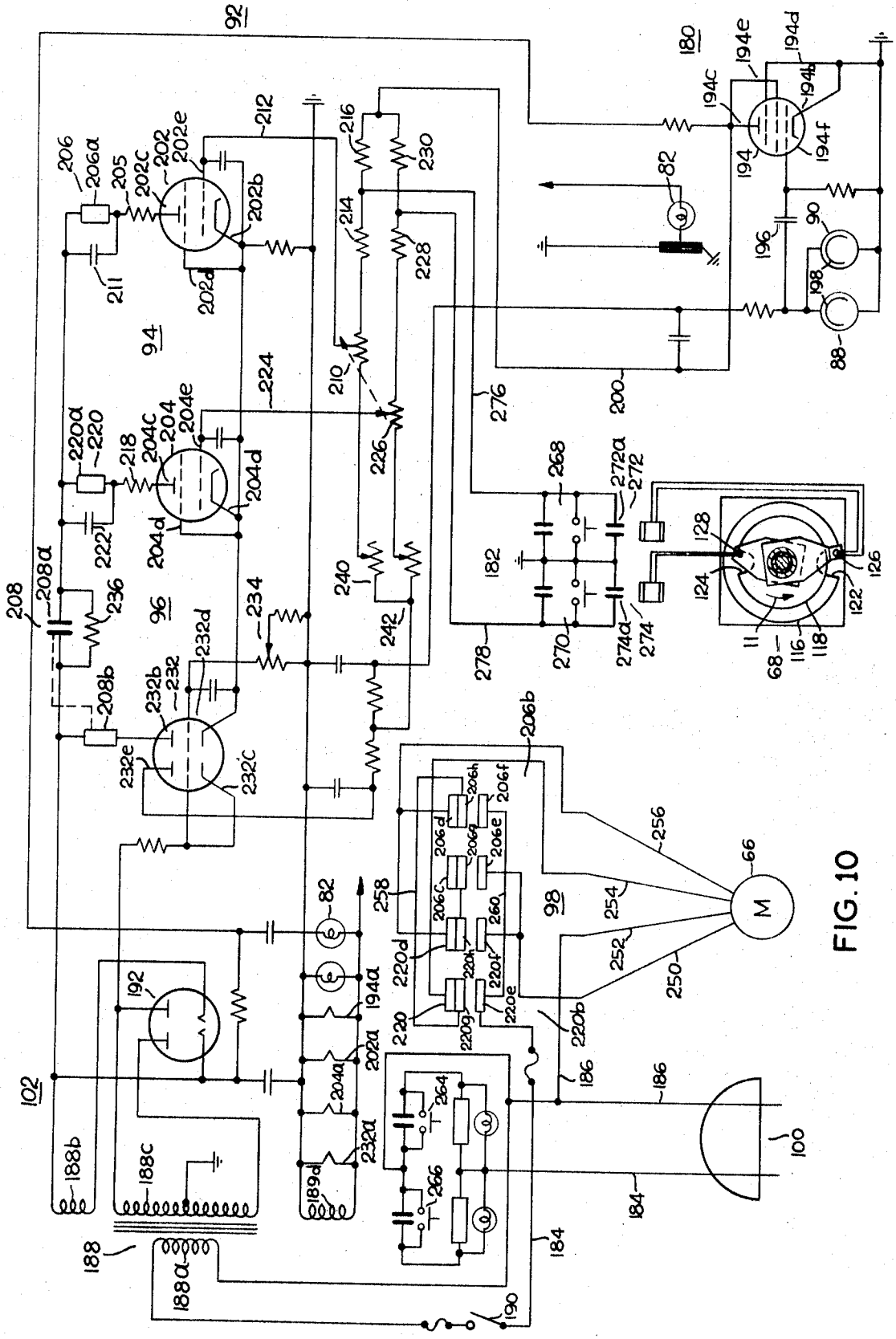


FIG. 10

REGISTRATION CONTROL TIMING SWITCH FOR WEB-PROCESSING MACHINE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to registration control systems for web-processing apparatus, such as cutting machines which cut blanks from a web of material containing repeated printed designs. More particularly, it relates to timing or selector switch means used in such control systems to achieve registry.

2. Description of the Prior Art

Typical apparatus for cutting blanks from a web of material containing repeat printed designs and corresponding register marks comprises a reciprocating cutting blade, intermittently-active feed rolls synchronized with the blade cycle for feeding a predetermined length of web to the blade, and continuously-active constant speed metering rolls which control web speed and, thus, the amount of web fed to the feed rolls. The metering rolls are driven through a variable speed transmission device which incorporates a correction motor which is selectively energizeable by a correction signal for rotation in either direction for short periods of time to make minor momentary adjustments in web speed, i.e., web length fed to the feed rolls. Such speed adjustments are necessary to avoid misregistration of the designs with the cutting blade due to undesirable and unpredictable minute differences in spacing between designs which arise during printing of the design on the web.

Detection and correction of potential misregistration is accomplished by a control system which detects the position of a particular register mark with respect to the blade at a given point in time in the operating cycle of the blade. If it appears that the register mark is in registry, no correction signal is sent by the control system to the correction motor. However, if misregistration is indicated and correction is required, the control system provides an appropriate control signal (advance or retard) to the correction motor to momentarily change web-feed speed. Some control systems include a photoelectric scanner located in a predetermined distance ahead of the blade for sensing the passage of register marks printed on the edge of the web (one mark being provided for each design) and for providing a register mark pulse upon passage of each mark. Such control systems further include a timing or selector switch responsive to blade position for defining a "scanning area," for each cycle of blade operation. The scanning area is divided into an advance zone, an in-register zone, and a retard zone. Such control systems also include circuitry for determining where each register mark pulse from the scanner occurs in the scanning area and provides an appropriate correction signal to the correction motor.

In practice, it sometimes happens that the designs printed on the web extend into the region "seen" by the scanner, i.e., the scanning area, and this would ordinarily result in false pulses being produced by the scanner. To compensate for this, it is necessary to be able to narrow the so-called "scanning area" seen by the scanner. It is also necessary to be able to shift the scanning area by manual controls so as to achieve proper registration.

Some prior art timing switches are capable of providing either or both of these functions. One such type of

prior art timing switch employs a rotating electrically conductive disc with a non-conductive insert in the periphery and commutating brushes which ride on the periphery of the disc. In such switches, the size of the insert determines the size of the scanning area and the "in register" interval and changing the position of the brushes shifts the scanning area. However, to make desirable adjustments in some installations, the cutting machine and switch must be stopped and the discs must be replaced or the brushes repositioned. While such prior art timing or selector switches are generally satisfactory for their intended purpose, it is impossible to make adjustments by means embodied in the switch itself. Furthermore, switches using the commutation principle are subject to mechanical wear which can affect their electrical operation and necessitates replacement of worn parts.

SUMMARY OF THE INVENTION

Web-processing apparatus and control means therefor in accordance with the present invention contemplates a web containing repeated designs and corresponding register marks along the side edge of the web (normally one mark for each design). Minute errors in spacing occur between each design due to printing techniques employed. Furthermore, portions of each design lie in the same path on the web as the register marks and tend to give false indications to the sensing device unless appropriate measures are taken.

The web-processing apparatus comprises a processing device, such as a cutter, for performing a process or operation on each design; a feed means, such as intermittently operable feed rollers, for repeatedly feeding a predetermined length of web to the cutter; and a metering means, such as constant speed metering rollers, for controlling the rate of speed at which the web is supplied to the feed, i.e., the amount of web supplied to the feed rollers.

The control means for maintaining the designs in registry with the processing device or cutter comprise correction means, such as a differential gear box through which the metering rollers are driven and a selectively energizable correction motor (operable momentarily in forward or reverse) on the transmission, for momentarily changing web speed. The control means also comprise scanning means, such as a photoelectric sensing device, a predetermined distance ahead of the cutter for sensing passage of each registry mark and for providing a register mark pulse in response thereto. The control means further comprise a selector or timing switch, hereinafter more fully described, responsive to the operative position of the cutter during each cycle of cutter operation for providing output signals which define a scanning area (actually a time interval) within which or during which the register mark pulse must occur in order for a proper cutting operation to ensue or for appropriate advance or retard adjustments to be made to web speed. The control means finally comprise a control circuit for comparing the relationship of the register mark pulse from the scanner with the scanning interval from the selector switch and for providing a correction signal (advance or retard) to the correction motor in the event the register mark pulse occurs at a time other than during a so-called "dead area" or "in register" zone in the scanning interval.

In accordance with the present invention, the selector or timing switch is designed so that the scanning in-

terval can be adjusted in two ways. First, the size (measured in the direction of web travel) of the scanning interval can be adjusted so as to prevent false signals from the scanner (caused by the scanner "seeing" portions of designs as well as register marks) from effecting a change in web speed. Second, the position of the scanning interval can be shifted to advance or retard web speed so that cutting occurs in the proper place on the web. The selector or timing switch comprises a support frame and rotatable drive shaft mounted on the frame and rotatable at least one revolution for each cycle of cutter operation, although other ratios are possible. Two circular discs of magnetizable metal are mounted on the shaft and are rotatable therewith. Each disc is provided with a notch or cutout in the periphery which provides a magnetic discontinuity in the disc. The discs are preferably disposed so that the notches are spaced 180° apart. A pair of magnetic pickup devices, one for each disc, is mounted on adjustable yokes on the frame. The magnetic pickups are spaced apart from each other by a predetermined angular distance and have a predetermined location with respect to the frame. Each complete revolution of the shaft and discs causes the magnetic pickups to produce a pair of spaced-apart electrical pulses and the interval between the pulses corresponds to the scaning interval. Means are provided to shift the magnetic pickup yokes either to change the length of the interval or to shift it so as to advance or retard web speed.

Controls for web-processing apparatus in accordance with the invention employ an improved timing or selector switch which defines a so-called "scanning area" which can be selectively adjusted in several ways while the web-processing apparatus and switch are in operation. In particular, the length of the scanning area or the position of the scanning area or both can be adjusted. Furthermore, no contact or friction occurs between switch components which produce electrical pulses and, consequently, no wear occurs and no replacement parts are needed. Adjustment or changes of output signals from the selector switch can be accomplished without the necessity of substituting components of different size or configuration and the switch is ideally suited for high-speed operation.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic diagram of web-cutting apparatus incorporating cut-off register control means in accordance with the present invention;

FIG. **2** is a cross-section view of the web-cutting apparatus shown schematically in FIG. **1**;

FIG. **3** is an enlarged top plan view of a portion of the web shown in FIGS. **1** and **2**;

FIG. **4** is an enlarged front elevation view of a selector switch shown in FIG. **1**;

FIG. **5** is a front view, partly in phantom, of the selector switch shown in FIG. **4**;

FIG. **6** is a cross-section view of the selector switch taken along line VI—VI of FIG. **5**;

FIG. **7** is a top plan view of the selector switch shown in FIGS. **4**, **5** and **6**;

FIG. **8** is a cross-section view of locking devices on the selector switch taken along line VIII—VIII of FIG. **4**;

FIG. **9** is a cross-section view of a portion of the cutter adjustment means on the selector switch taken along line IX—IX of FIG. **4**; and

FIG. **10** is a circuit diagram of portions of the control means shown in FIG. **1**.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. **1** of the drawings, there is shown schematically a web-cutting machine and control circuitry therefor in accordance with the present invention. The cutting machine operates to cut blanks from a web **10** of material, such as paper, on which evenly spaced, repeat designs **12** are printed, as shown in FIG. **3**. Web **10** is provided in a path along one edge thereof with evenly spaced printed register marks **14**, one mark being provided for each design. However, minute errors occur in spacing between successive designs and successive register marks caused during printing. Typically, each register mark **14** has a width (measured in the direction of web travel) of about 3/32 inch to ¼ inch. Furthermore, in some instances, the designs extend into the path occupied by the register marks and this results in erroneous cutting.

WEB CUTTING MACHINE

As FIGS. **1** and **2** show, the cutting machine comprises a suitable supporting framework or structure **16** on which a web supply roller **18**, decurling rollers **20**, web guides **22**, and web-support plates **24** are mounted and through or around which web **10** passes. The cutting machine also comprises metering means, such as a metering roll **26** and an associated nip-roller **28** which normally feeds web **10** at a predetermined constant rate of speed to web feeding means, such as a pair of intermittently operable feed rollers **30** and **32**. The feed rollers **30** and **32**, which are adjustable, periodically feed a predetermined length of web to intermittently operable cutting means such as the cutting blades or dies **34** and **36**.

As FIG. **2** shows, operating power for the cutting machine is provided by a main drive electric motor **38** which rotates a main drive shaft **40** through a drive means **42**. Main drive shaft **40** is connected through a drive means **44** to drive an eccentric cam **46** to which a reciprocally movable cutter blade drive rod **48** is connected. Drive rod **48** effects reciprocating cutting movement of movable blade or die **34** at a constant rate of speed. Main drive shaft **40** is also connected through another drive means **50** to drive a secondary drive shaft **52** which is mounted for rotation on framework **16**. Secondary drive shaft **52** is connected through a gear train **54** to drive the feed rollers **30** and **32** which rotate intermittently. It is to be understood that the movable cutting blade or die **34** operates in synchronism with the feed rollers **30** and **32**, i.e., each advance of a blank by the feed rollers is followed by a corresponding cutting operation. Furthermore, it is to be understood that the gears in gear train **54** are so-called "change gears" which are replaceable by gears of various sizes depending on the size of the blanks to be cut from the web. Secondary drive shaft **52** is also connected through another drive means **56** to the input gear **58** of a differential transmission **60** which has an output gear **62** for driving metering roll **26**.

Differential transmission **60** is provided with a correction motor **64** momentarily energizable in forward or reverse directions to increase or decrease, respectively, the speed of output gear **62** and thus change the

speed of metering roll 26 and the amount of web fed thereby to feed rollers 30 and 32.

A timing or selector switch 68, hereinafter described in detail, is mounted on framework 16 and a rotatable drive shaft 70 thereof is provided with a drive gear 72 which meshes with a gear 74 on a shaft 76 of feed rollers 32.

A scanner 80 is mounted on framework 16 a predetermined distance ahead of the cutting blades 34 and 36. Scanner 80, preferably of the "diffused reflection of light" type, comprises a light source 82, a lens 84 which focuses the light at a point 86 in the path of the register marks on the web, as FIGS. 1 and 4 show, and a pair of photoelectric cells 88 and 90 which are also focused on point 86. Scanner 80 is responsive only to the leading edge of each register mark and produces a single sharp electrical pulse for each register mark which is suitably amplified and utilized as hereinafter described. If preferred, however, other types of scanners could be employed.

CONTROL SYSTEM GENERALLY

Referring to FIG. 1, it is seen that a control system (shown schematically in FIG. 1 and in detail in FIG. 10) comprises scanner 80, timing or selector switch 68, correction motor 66 on transmission 60, a comparator circuit 92, comprising a thyratron circuit 94 and a time-delay circuit 96 for comparing output signals from scanner 80 and selector switch 68 to determine if correction motor 66 is to be energized, a motor-reversing circuit 98 operable in response to control circuit 92 to effect operation of correction motor 66, and a source of power 100 and a power supply circuit 102 for providing operating power to the several elements in the control system, as hereinafter described in connection with FIG. 10.

TIMING SWITCH

Timing or selector switch 68 shown in FIGS. 4 through 9 of the drawings comprises a supporting structure having a back plate 104, a front plate 106, and four studs 108 for securing the plates together in spaced-apart relationship. Back plate 104 is provided with suitable flanges 110 for rigidly securing switch 69 to the supporting framework 16 of the cutting machine. Back plate 104 carries a bearing 112, shown in FIG. 6, for supporting one end of rotatable switch shaft 70 which is adapted to be driven, as hereinbefore explained, through suitable gears 72 and 74 by feed roll 32. The other end of switch shaft 70 is supported on a bearing 114 hereinafter described.

First and second adjacent circular discs 116 and 118, made of ferromagnetic material such as steel, are mounted on switch shaft 70 for rotation therewith. Each disc is provided with set screw means 120 on its hub to permit mounting and angular adjustment of the disc with respect to switch shaft 70. The discs 116 and 118 are provided with notches or cutouts 122 and 124, respectively, on their peripheries for actuating magnetic pickup devices 126 and 128, respectively, located in proximity to the discs.

Each magnetic pickup device 126 and 128 is understood, for example, to comprise a small magnet and a coil solidly encapsulated within a rugged stainless steel shell. Each magnetic pickup generates a voltage output or electrical pulse when ferro-magnetic material enters the magnetic field surrounding a pole piece at the sensing end of the pickup with sufficient speed. More specifically, the dynamic discontinuity provided by the notch or cutout in each disc as it enters the magnetic field around its associated magnetic pickup device produces an electric voltage or pulse. Such magnetic pickups are known in the art and the present invention employs a type designated Model 4947 manufactured by Automation Engineering Co., Inc., Mequon, Wisconsin, and shown in that company's bulletin MPB–269. The pulses from the magnetic pickup devices 126 and 128 are used to actuate relays 272 and 274, hereinafter described. Each relay 272 and 274 has a delayed break, i.e., its contacts are adjustable to close and stay closed for a predetermined interval of time, on the order of 0.05 to 1 seconds, depending on the time interval selected. Such a relay is known and is described in bulletin MP–969 of Electro Products Laboratories, Inc., Chicago, Illinois.

Magnetic pickup device 128 is supported in proximity to disc 118 by means of an adjustable yoke 134 which comprises an arm 136 which is rigidly secured to the inner end of a cylindrical sleeve 138 surrounding but unattached to switch shaft 70. The outer end of sleeve 138 extends through front plate 106 of the switch and has a combined adjustment knob 140 and dial plate 142 rigidly secured to the sleeve. Knob 140 is supported by bearing 114 on the outer end of switch shaft 70 which allows for relative movement between the knob and the switch shaft.

Magnetic pickup device 126 is supported in proximity to disc 116 by means of an adjustable yoke 144 which comprises an arm 146 which is rigidly secured to the inner end of a cylindrical sleeve 148 surrounding but unattached to sleeve 138 of yoke 134 hereinbefore described. The outer end of sleeve 148 extends through front plate 106 of the switch and has a combined adjustment knob and dial plate 150 rigidly secured thereto. Dial plate 142 is recessed within dial plate 150 but is relatively movable with respect thereto. More specifically, locking device 152 comprises a head 156, a collar 157, and a threaded shank 158 which engages a threaded opening 160 in dial plate 150. When locking device 152 is tightened, collar 157 bears against both dial plates 142 and 150 and prevents relative movement between the dial plates and their associated yokes 134 and 144, respectively. Locking device 154 comprises a head 162, a collar 164 and a threaded shank 166 which engages a threaded opening in front plate 106. When locking device 154 is tightened, collar 164 bears against dial plate 150 and relative movement between dial plate 150 and front plate 106 is prevented.

As FIGS. 4, 6, 7 and 9 show, a cutting adjustment gear 170 is rigidly secured to sleeve 148 of outer yoke 148 by a set screw 172 and is rotatable by means of a cutting adjustment knob 174 and gear 176 on front plate 106 of the switch to effect simultaneous rotational movement of both yokes 134 and 144 (when they are locked together by locking device 152) to make timing adjustments in the registration of web 10 with cutting blades 34 and 36. Referring to FIG. 5, counterclockwise rotation of both cutting yokes 134 and 144 by means of adjusting knob 174 effects an "advance" registration adjustment and clockwise rotation effects a "retard" adjustment.

CONTROL SYSTEM IN DETAIL

FIG. 10 is a circuit diagram of the control system in

accordance with the invention. Generally considered, the control system comprises a power source **100**, a power-supply circuit **102**, a scanner and pulse amplifier circuit **180** including scanner **80**, a selector switch circuit **182** including selector switch **68**, a comparator circuit **92** including thyratron circuit **94** and time-delay circuit **96**, and motor-reversing circuit **98** including correction motor **66**.

Power source **100** supplies electrical power such as 110 volt, 60 cycle alternating current to two supply lines **184** and **186**. Power supply circuit **102** comprises a power transformer **1** having a primary winding **188***a* and three secondary windings **188***b*, **188***c* and **188***d*. An on-off switch **190** is in circuit between power line **184** and primary winding **188***a* of transformer **188**. Power supply circuit **102** further comprises a full-wave rectifier tube **192** to which the secondary windings **188***b*, **188***c* and **188***d* are connected, thereby providing a regulated DC voltage to control system components and circuits, as hereinafter appears.

Scanner and pulse-amplifier circuit **180** comprises light source **82**, photoelectric cells **88** and **90** which are connected in parallel, and an amplifier tube **194** which amplifies a pulse received from the photoelectric tubes when the light beam from light source **82** is interrupted by register mark **14** on web **10**. Heater **194***a* of tube **194** is connected across secondary winding **188***d* of power transformer **188**. Cathode **194***b* of tube **194** is connected to ground and plate **194***c* is connected to power supply circuit **102**. Biasing grids **194***d* and **194***e* are connected to the cathode and plate, respectively, in tube **194**. Control grid **194***f* of tube **194** is connected through a capacitor **196** to the cathodes **198** of photoelectric cells **88** and **90**. The amplified register mark pulse is transmitted through a conductor **200** to comparator circuit **92**, as hereinafter described.

Comparator circuit **92** includes thyratron circuit **94** and time-delay circuit **96**. Thyratron circuit **94** comprises two thyratron tubes **202** and **204** which are understood to be grounded and ungrounded alternately by selector switch circuit **182**, as hereinafter described. Thyratron tube **202** commprises a heater element **202***a* which is connected across secondary winding **188***d* of power transformer **188**. The cathode **202***b* of tube **202** is connected to power supply circuit **102**. The plate **202***c* of tube **202** is connected through a resistor **205** to one side of the operating coil **206***a* of a motor-reversing relay **206**. The other side of coil **206***a* is connected through normally-open contacts **208***a* of a time-delay relay **208** to power supply circuit **102**. A capacitor **210** is connected across relay coil **206***a*. The biasing grid **202***d* of tube **202** is connected to power supply circuit **102**. A biasing or firing grid **202***e* of tube **202** is connected to a sensitivity-control rheostat **210** through a conductor **212**. Rheostat **210** is connected through resistors **214** and **216** to conductor **200** which supplies the amplified register mark pulse. As hereinafter explained, presentation of a register mark pulse signal to control grid **202***e* of tube **202** can effect firing of the thyratron only in the event that the thyratron is not in ungrounded condition as hereinafter explained. More specifically, control grid **202***e* of tube **202** is periodically grounded by timing switch circuit **182** and is, therefore, unable to effect firing of tube **202**.

Thyratron tube **204** comprises a heater element **204***a* which is connected across secondary winding **188***d* of power transformer **188**. The cathode **204***b* of tube **204** is connected to power supply circuit **102**. The plate **204***c* of tube **204** is connected through a resistor **218** to one side of the operating coil **220***a* of a motor-reversing relay **220**. The other side of coil **220***a* is connected through normally open contacts **208***a* of a time-delay relay **208** to power supply circuit **102**. A capacitor **222** is connected across relay coil **220***a*. The biasing grid **204***d* of tube **204** is connected to power supply circuit **102**. A biasing or firing grid **204***e* of tube **204** is connected to a sensitivity-control rheostat **226** through a conductor **224**. Rheostat **226** is connected through resistors **228** and **230** to conductor **200** which supplies the amplified register mark pulse. As hereinafter explained, presentation of a register mark pulse signal to control grid **204***e* of tube **204** can effect firing of the thyratron only in the event that the thyratron is not in ungrounded condition. More specifically, control grid **204***e* of tube **204** is periodically grounded by timing switch circuit **182** and is, therefore, unable to effect firing of tube **204**.

If thyratron tube **202** or **204** is fired, the tube is held in firing condition for a predetermined time interval by time-delay circuit **96** so that relay **206** or **220** respectively may be energized for a length of time necessary to effect energization of correction motor **66**. Time-delay circuit **96** comprises a multi-vibrator type electron tube **232**, a time-delay relay **208** which comprises normally open relay contacts **208***a* and a relay coil **208***b*, and a potentiometer **234** for adjusting the length of the time delay. Heater element **232***a* of tube **232** is connected across secondary winding **188***d* of power transformer **188**. Relay coil **208***b* of time-delay relay **208** is connected between plate **232***b* of tube **232** and power supply circuit **102**. The cathode **232***c* of tube **232** is also connected to power supply circuit **102**. The control grid **232***d* of tube **232** is connected to potentiometer **234**. A resistor **236** is connected across contacts **208***a* of time-delay relay **208**. The other plate **232***e* of tube **232** is connected to a pair of balancing potentiometers **240** and **242** which, in turn, are connected to the sensitivity controls **210** and **226**, respectively.

Motor reversing relays **206** and **220** comprise relay coils **206***a* and **220***a*, hereinbefore described, and sets of forward and reverse relay contacts **206***b* and **220***b*, respectively. These sets of relay contacts are located in motor reversing circuit **98**, shown in FIG. **10**. The set of forward relay contacts **206***b* comprise a pair of stationary upper contacts **206***c* and **206***d*; a pair of stationary lower contacts **206***e* and **206***f*; and a pair of movable contacts **206***g* and **206***h* operated by relay coil **206***a*. The set of reverse relay contacts **220***b* comprise a pair of stationary upper contacts **220***c* and **220***d*; a pair of stationary lower contacts **220***e* and **220***f*; and a pair of movable contacts **220***g* and **220***h* operated by relay coil **220***a*. In motor-reversing circuit **98**, the sets of relay contacts **206***b* and **220***b* and the leads **250**, **252**, **254** and **256** of motor **66** are interconnected as follows to effect forward and reverse rotation of the motor when the relays are operated.

FIG. **10** shows both motor-reversing relays **206** and **220** in contact open position whereby motor **66** is de-energized. When coil **206***a* of forward relay **206** is energized to rotate motor **66** in the forward direction (for example, to speed up meter roller **26**), movable contacts **206***g* and **206***h* of relay **206** move from the position shown in FIG. **10** to a position wherein they engage the lower stationary contacts **206***e* and **206***f*,

respectively. In this condition, motor lead 252 is connected directly to line 186. Motor lead 254 is connected to line 184 through contact 220*c*, 220*g*, conductor 258, contact 206*h*, contact 206*f*, conductor 260, and contact 220*e*. Motor lead 250 and motor lead 256 are connected in series with each other through contact 206*e*, 206*g*, 220*h* and 220*d*. Motor 66 is thus connected and energized for rotation in the forward direction to speed up meter roller 26 as long as relay contacts 206*b* are closed. When relay contacts 206*b* open, the movable contacts return to the position shown in FIG. 10 and motor 66 stops.

When coil 220*a* of reverse relay 220 is energized to rotate motor 66 in the reverse direction (for example, to slow down meter roller 26), movable contacts 220*g* and 220*h* of relay 220 move from the position shown in FIG. 10 to a position wherein they engage lower stationary contacts 220*e* and 220*f*, respectively. In this condition, motor lead 252 is connected to line 186. Motor lead 256 is connected to line 184 through contact 206*d*, 206*h*, conductor 258, contact 220*g*, and contact 220*e*. Motor conductors 250 and 254 are connected in series with each other through contact 220*f*, contact 220*h*, contact 206*g*, and contact 206*c*. Motor 66 is thus connected and energized for rotation in the reverse direction to slow down meter roller 26 as long as relay contacts 220*b* are closed. When relay contacts 220*b* are open, the movable contacts 220*g* and 220*h* return to the position shown in FIG. 10 and motor 66 stops.

The forward and reverse relay contacts 206*b* and 220*b* are usually operated in response to energization of the relay coils 206*a* and 220*a*, respectively, which are controlled by the thyratron tubes 202 and 204, respectively. However, it is to be understood that forward and reverse relay contacts 206*b* and 220*b* can be operated to effect operation of motor 66 as hereinbefore described by normally open inching switches 264 and 266, respectively, directly from power source 100 or by additional normally open inching switches 268 and 270, respectively, in selector switch circuit 182.

Selector switch circuit 182 comprises timing or selector switch 68 which has two magnetic pickups 126 and 128, hereinbefore described. The magnetic pickups 126 and 128 are connected to magnetic pickup relays 272 and 274, respectively. The normally open contacts 272*a* of relay 272 have one side connected to ground and the other side connected through a conductor 276 to sensitivity control 210 through resistor 214. The normally open contacts 274*a* of relay 274 have one side connected to ground and the other side connected through a conductor 278 to sensitivity control 226 through resistor 228.

SCANNING AREA

Timing or selector switch 68 operates to define a time interval or scanning interval which, for purposes of discussion, may be considered as an imaginary scanning area 15, shown in FIG. 3, which is divided into three zones, namely, a retard zone 17, an in-register zone 19, and an advance zone 21. Scanning area 15 needs to be adjustable in several ways. First, the width of in-register zone 19 should be slightly wider that the width of a particular register mark 14. Second, the entire width of scanner area 15 should be such that it will not superimpose itself on any portion of a printed design 12, when fitted between two adjacent designs, as FIG. 3 shows. In practice, assuming a one-to-one ratio between rotation of timer switch 68 and rotation of feeder roll 32 and one cycle of operation of cutter 34, the width of advance zone 21 is usually equivalent to about 30° of angular distance on feed roll 32. Similarly, the width of retard zone 17 of scanner area is usually equal to about 30 degrees of angular distance on feed roller 32. In such a relationship, the width of advance zone 21 is equal to one-twelfth the cut-off length of each design and the width of retard zone 17 equal to one-twelfth the cut-off length of one design. For example, if a design is to be cut every 12 inches on web 10, advance zone 21 would equal 1 inch and retard zone 17 would also equal 1 inch. The width of advance zone 21 is determined by the time setting of relay 272 and the width of retard zone 17 is determined by the time setting of relay 274. Advance zone 21 is adjustable toward and away from retard zone 17 so as to permit a desired width of in-register zone 19. This adjustment is accomplished by angularly moving magnetic pickups 128 and 126 so as to enlarge or diminish angle alpha between them. Scanning area 15 can also be shifted toward or away from point 86 shown in FIG. 3. Such shifting is accomplished by rotating magnetic pickups 126 and 128 simultaneously in either the clockwise or counterclockwise direction with respect to FIG. 5. As hereinafter explained in detail, scanning area 15 can be shifted so that either advance zone 21, in-register zone 19, or retard zone 17 appear to overlie point 86. If in-register zone 19 appears to overlie point 86, the register mark pulse will be in register and no correction of meter roll 26 will be initiated by motor 66. If scanning area 15 is shifted so that advance zone 21 appears to overlie point 86, the register mark pulse comes up late and an advance signal is sent to correction motor 66 to speed up meter roll 26. If scanning area 15 is shifted so that retard zone 17 appears to overlie point 86, the register mark pulse comes too soon and a retard signal is sent to correction motor 66 to slow down meter roll 26 to bring the next register mark to correct position. Normally, scanning area 15 is adjusted so that in-register zone 19 appears to overlie point 86. In this situation, correct cutting will occur. Misregistration caused by the register mark pulse occurring too soon or too late with respect to in-register zone 19 defined by timing switch 68 results in an appropriate correction signal being sent to correction motor 66.

Advance zone 21 is adjustable away from retard zone 17 so as to permit a change in the size of in-register zone 19, so that the width of the in-register zone is slightly larger than the width of a register mark. Changes in the width of in-register zone 19 are accomplished by moving the magnetic pickups 126 and 128 on timing switch 68 with respect to each other. For example, referring to FIGS. 5 and 10, if angle alpha is decreased, the width of in-register zone 19 in scanning area 15 will be expanded. Conversely, if angle alpha is increased, the width of in-register zone 19 will decrease. These adjustments are made as follows. Referring to FIG. 4, both locks 152 and 154 are unlocked. The position of magnetic pickup 126 is adjusted by turning dial 150 so that the beginning of the scanning area can be adjusted at a predetermined point in time with respect to cutter 34. Then, locking device 152 is locked so that dial 150 cannot be moved. Then, the position of magnetic pickup 128 with respect to magnetic pickup 126 is adjusted by turning dial 140. Then lock-

ing device **154** is locked so that dial **142** cannot be moved. The adjustments to switch **68** thus far described merely define the total width of scanning area **15** and, in particular, the width of in-register zone **19.**

It is apparent from the construction of switch **68** that the adjustments described hereinbefore can be carried out while the web-cutting apparatus and switch **68** are in operation.

In a situation where it is desired to shift the entire scanning area **15** either forward or backward with respect to a register mark **14,** assuming that the size of the in-register area has been selected and switch **68** adjusted accordingly, it is necessary to unlock locking device **154.** Then cutter adjustment knob **174** is rotated in the desired direction and for a desired amount so as to move both yokes **134** and **144** simultaneously for the desired distance in the desired direction. This movement of both yokes simultaneously has the effect of shifting the scanning area. In practice, it causes motor **66** to be energized sooner or later to effect advance and retard corrections with respect to a point in the operation of cutting blade **134.**

OPERATION

The web cutting apparatus and control means in accordance with the invention operate as follows. Assume that the web-cutting apparatus is in operation and that web **10** is passing under scanner head **80.** Further assume that switch **190** is closed and that all control circuits are receiving operating power. Also assume that selector switch **68** is rotating in the direction of arrow **11** and is in synchronism with the reciprocating operation of cutter blade **34** in a one-to-one ratio. Finally assume that notch **122** in the larger disc **116** of timing switch **68** has just passed magnetic pickup **126** and that contacts **272***a* of pickup relay **272** are closed. This closure of relay contacts **272***a* marks the start of the scanning interval. The length of time contacts **272***a* remain closed defines the width of retard zone **17** of scanning area **15.** With contacts **272***a* closed, control grid **202***e* of thyratron tube **202** is grounded through conductor **212,** sensitivity control **210,** conductor **276,** and contacts **272***a*. However, since contact **274***a* of pickup relay **274** are open, the control grid **204***e* of thyratron tube **204** is ungrounded.

Now assume that a register mark **14** interrupts the light beam from light source **82** to photoelectric cells **88** and **90** as web **10** passes under scanner head **80.** Further assume that this interruption occurs while pickup relay **272** is closed, i.e., that the register mark pulse occurs in retard zone **17** of scanning area **15.** Interruption of the light beam causes photoelectric cells **88** and **90** to produce a register mark pulse in conductor **196** which is transmitted to amplifier tube **194** and amplified therein. The amplified register pulse is transmitted through conductor **200** and through both sensitivity controls **210** and **226** and through conductors **212** and **224,** respectively, to the control grids **202***e* and **204***e*, respectively, of the thyratron control tubes **202** and **204,** respectively. Since conrol grid **202***e* of tube **202** is grounded, the presentation of the amplified register mark pulse to its control grid **202***e* is ineffective to fire tube **202.** However, since tube **204** is ungrounded, appearance of the amplified register mark pulse at its control grid **204***e* causes tube **204** to fire. When tube **204** fires, relay coil **220***a* of motor relay **220** is energized and contacts **220***a* of motor reversing relay **220** close to energize motor **66** for rotation in the reverse (retard) direction. Tube **204** is held on firing condition and relay **220** remains energized for a time interval determined by the length of time timing relay contacts **208***a* of timing circuit **96** remain closed. When this interval expires, timing relay contacts **208***a* open to deenergize relay coil **220***a* of motor relay **220.** As discs **116** and **118** of timing switch **68** continue to kotate, contacts **272***a* of pickup relay **272** reopen and tube **202** is no longer grounded.

Now assume that interruption of the light beam occurs while pick-up relays **272** and **274** are both open, i.e., in the "in register" zone of scanning area. As is apparent, the amplified register mark pulse is then presented to control grids **202***e*, **204***e* of tubes **202** and **204** simultaneously, but since relay contacts **208***a* of timing relay **208** are open, neither coil **204***a* nor coil **220***a* of motor relays **206** and **220** will be energized and no correction signal will be presented to motor **66.** In this situation, the register mark pulse appears in the "in-register" zone of scanning area.

As discs **116** and **118** of timing switch **68** continue to rotate, a point is reached where slot **124** of inner disc **118** passes magnetic pickup **128,** thereby causing pickup relay **274** to be energized and its contacts **274***a* to close for a predetermined interval of time. The length of time contacts **274***a* remain closed defines the width of advance zone **19** of scanning area **15.** With contacts **274***a* closed, tube **204** is grounded because its control grid **204***e* is connected to ground through conductor **224,** sensitivity control **226,** resistor **228,** conductor **278** and contacts **274***a*.

Now assume that the interruption of the light beam occurs while pickup relay **274** is closed, i.e., in the "advance" zone of scanning interval. Since the amplified register mark pulse is presented to control grid **204***e* of tube **204** while tube **204** is grounded, tube **204** will not fire. However, the register mark pulse is simultaneously presented to control grid **202***e* of tube **202** while tube **202** is ungrounded and tube **202** fires. Relay coil **206***a* of motor relay **206** is thereby energized, its contacts **206***e* close and motor **66** is energized for rotation in the forward (advance) direction to increase the speed of meter roll **26.** Tube **202** is held in firing condition and relay **206** remains energized for a time interval determined by the length of time timing relay contacts **208***a* of timing circuit **96** remain closed. When this time interval expires, timing relay contacts **208***a* open to deenergize relay coil **206***a* of motor relay **206.**

I claim:

1. Web processing apparatus for a web containing repeated designs and corresponding register marks comprising:

a processing device operable to perform a process on each design,

feed means for repeatedly feeding a predetermined length of web to said processing device, and

metering means for supplying a predetermined length of web to said feed means, said metering means normally operating at a constant speed when said designs are in registry with said processing device, and

control means for said web processing apparatus for maintaining the designs in registry with said processing device, said control means comprising:

correction means operable to momentarily change the speed of said metering means to supply a different length of web to said feed means,

scanning means in fixed location with respect to said processing device for sensing passage of a register mark and for providing a register mark pulse in response thereto,

a selector switch responsive to the position of said processing device for providing output signals for each cycle of operation of said processing device definitive of a scanning interval during which a process will be performed on a design by said processing device, said scanning interval comprising advance, retard and in-register zones, and

a control circuit for comparing the relationship of a register mark pulse to a scanning interval and for providing a correction signal to said correction means in the event said register mark pulse occurs at a time during said scanning interval other than in the in-register zone; said selector switch comprising:

a pair of pulse producing means for producing a pair of output pulses spaced apart in time which define the limits of said scanning interval for a cycle of operation of said processing device,

first adjustable means for selectively changing the length of the spacing between said pulse producing means to change the time interval between said pair of pulses to change the width of said scanning interval, and

second adjustable means for selectively changing the position of at least one of said pulse producing means to shift one end of the time interval with respect to the cycle of operation of the processing device so as to shift the scanning interval with respect to the processing device.

2. The combination according to claim **1** wherein said pulse producing means comprises a support, a pair of pickup devices mounted on said support, and rotatable means synchronized with the cycle of operation of said processing device for causing said pickup devices to produce said output pulses.

3. The combination according to claim **2** wherein said first adjustable means in said selector switch comprises means for changing the angular distance between said pair of pickup devices.

4. The combination according to claim **3** wherein said second adjustable means in said selector switch comprises means for changing the relative angular relationship between said pair of pickup devices and said rotatable means.

5. The combination according to claim **4** including a shaft rotatable on said support and on which said rotatable means are fixed, and wherein said first and second adjustable means comprise a pair of movable yokes mounted on said support, each yoke supporting one of said pickup devices.

6. The combination according to claim **5** wherein said rotatable means comprise a pair of discs mounted on said shaft, each disc being associated with one pickup device and having means thereon for actuating its associated pickup device.

7. The combination according to claim **6** wherein said pickup devices are magnetic pickup devices and wherein the means on each disc for actuating an associated pickup device is a discontinuity in the disc.

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