United States Patent [19]

Coberley

[11] **3,898,645**

[45] **Aug. 5, 1975**

[54] **DISPLAY APPARATUS FOR A REGISTRATION CONTROL SYSTEM WHERE MOVEMENT IS REPRESENTED BY ENCODER PULSES**

[75] Inventor: **Daniel A. Coberley**, Danville, Ill.

[73] Assignee: **Hurletron Altair**, Danville, Ill.

[22] Filed: **Jan. 28, 1974**

[21] Appl. No.: **436,987**

[52] **U.S. Cl.** ..... **340/324 A**; 250/557; 315/367

[51] **Int. Cl.** **G06f 3/14**

[58] **Field of Search** ..... 340/324 A, 324 AD, 259, 340/260, 268; 315/27, 19, 367, 369; 250/557, 223 R; 235/92 MP

[56] **References Cited**

UNITED STATES PATENTS

3,221,337	11/1965	Quinn et al.	250/557
3,447,123	5/1969	Bettcher	315/27
3,594,552	7/1971	Adamson et al.	235/92 MP
3,662,176	5/1972	Kamentsky et al.	250/223 R

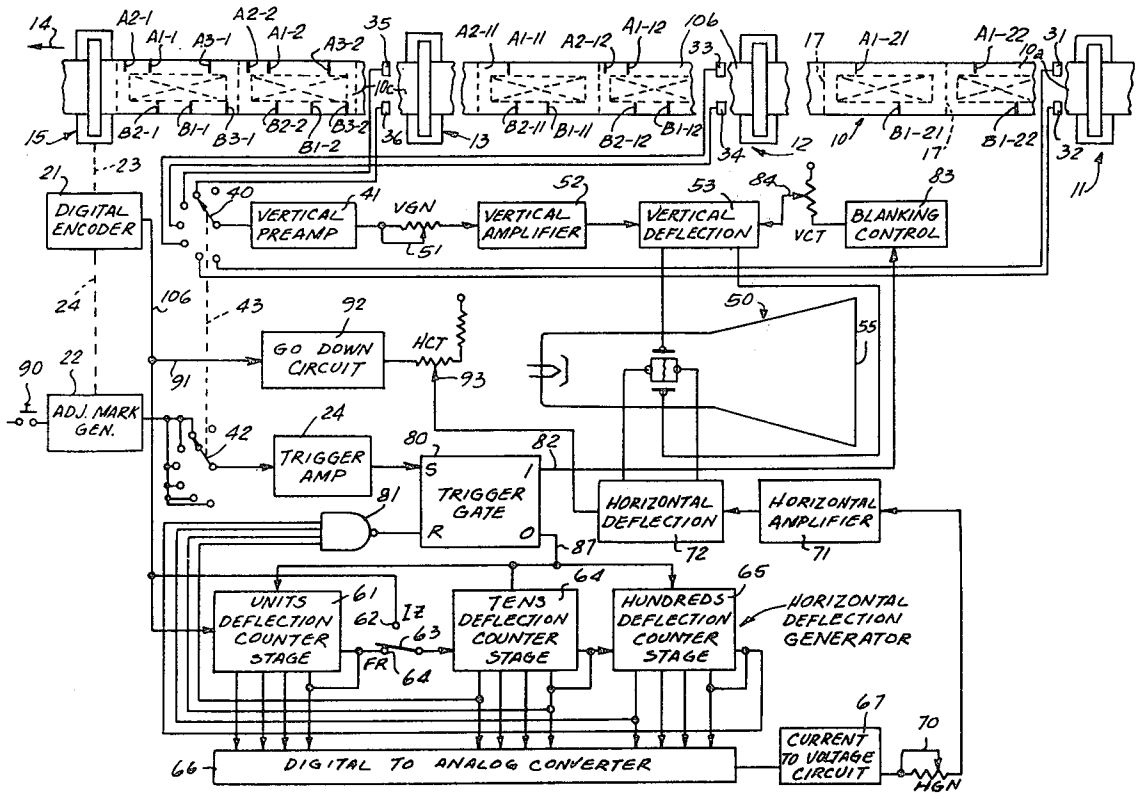
Primary Examiner—Marshall M. Curtis

Attorney, Agent, or Firm—Hill, Gross, Simpson, Van Santen, Steadman, Chiara & Simpson

[57] **ABSTRACT**

In a registration control system for moving material, a single or dual trace oscilloscope is operated from encoder pulses generated as a function of movement to display one or a pair of scanner channels. The horizontal deflection rate may be switched to a multiple of the normal rate to provide full deflection during display of an inspection zone of interest so as to facilitate selection of a stable scanner pulse for registration control.

10 Claims, 12 Drawing Figures



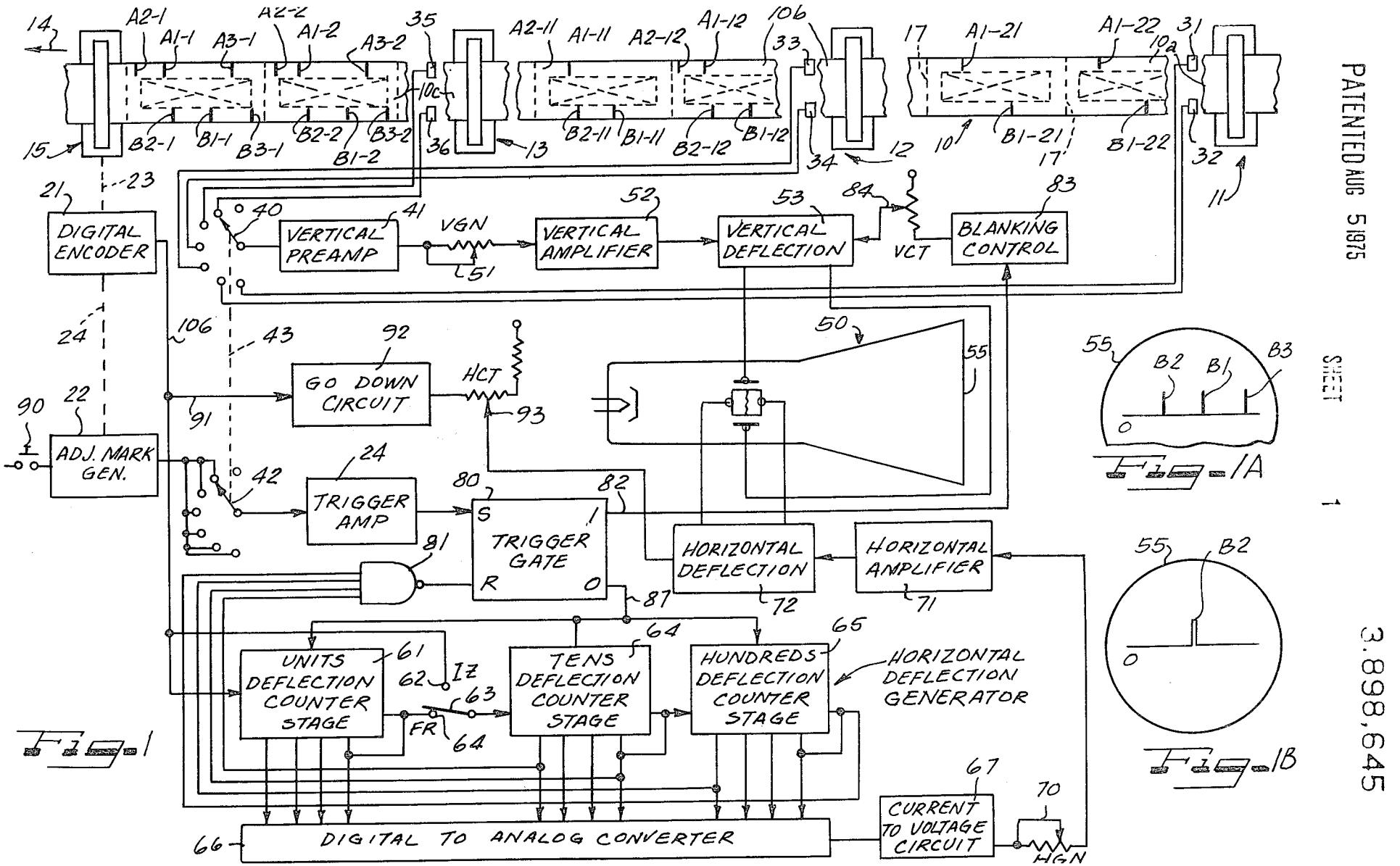


Fig-1

Fig-1A

Fig-1B

Fig. 2A

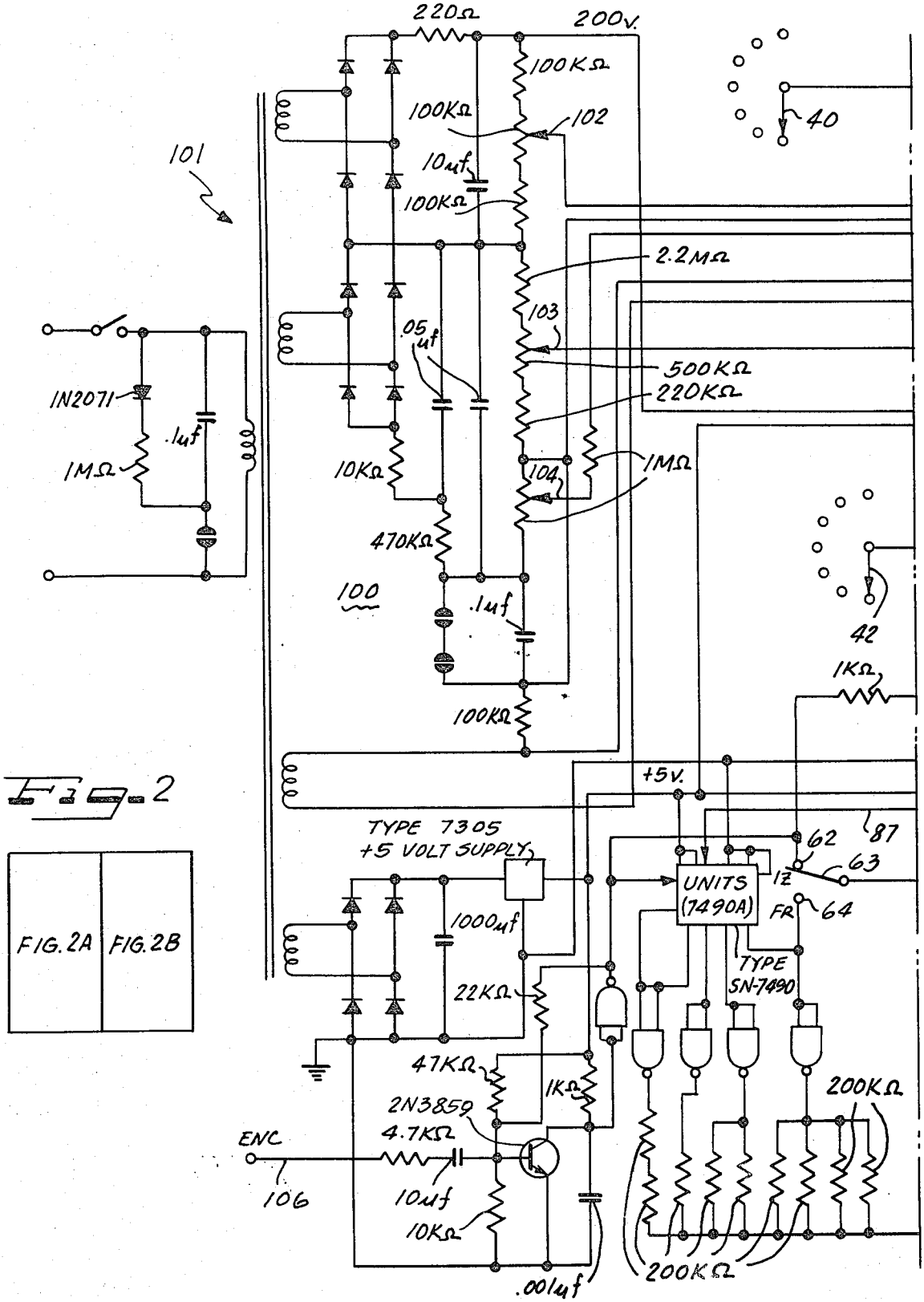


Fig. 2

FIG. 2A	FIG. 2B

Fig. 4B

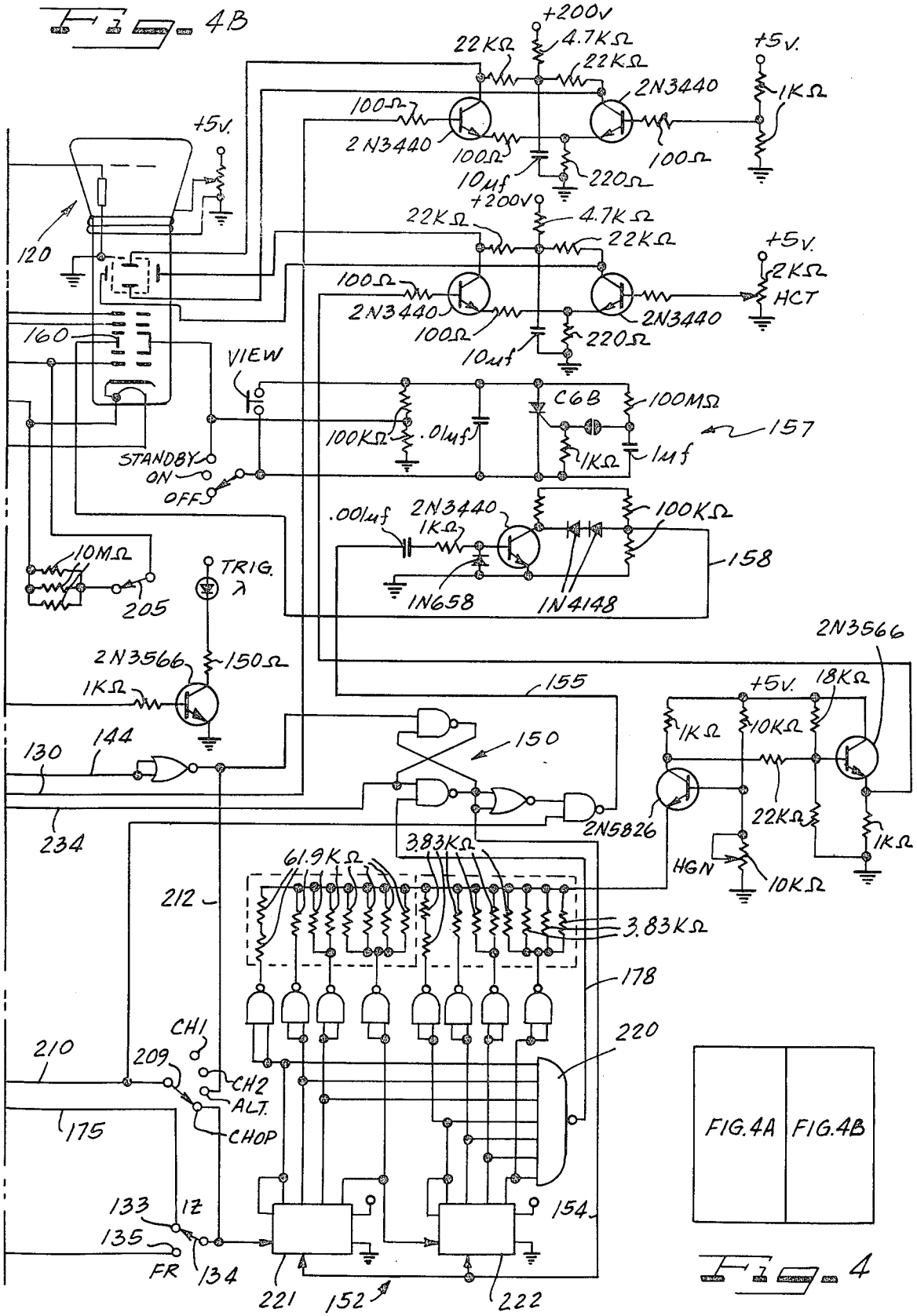


FIG. 4A | FIG. 4B

Fig. 4

Fig. 4A

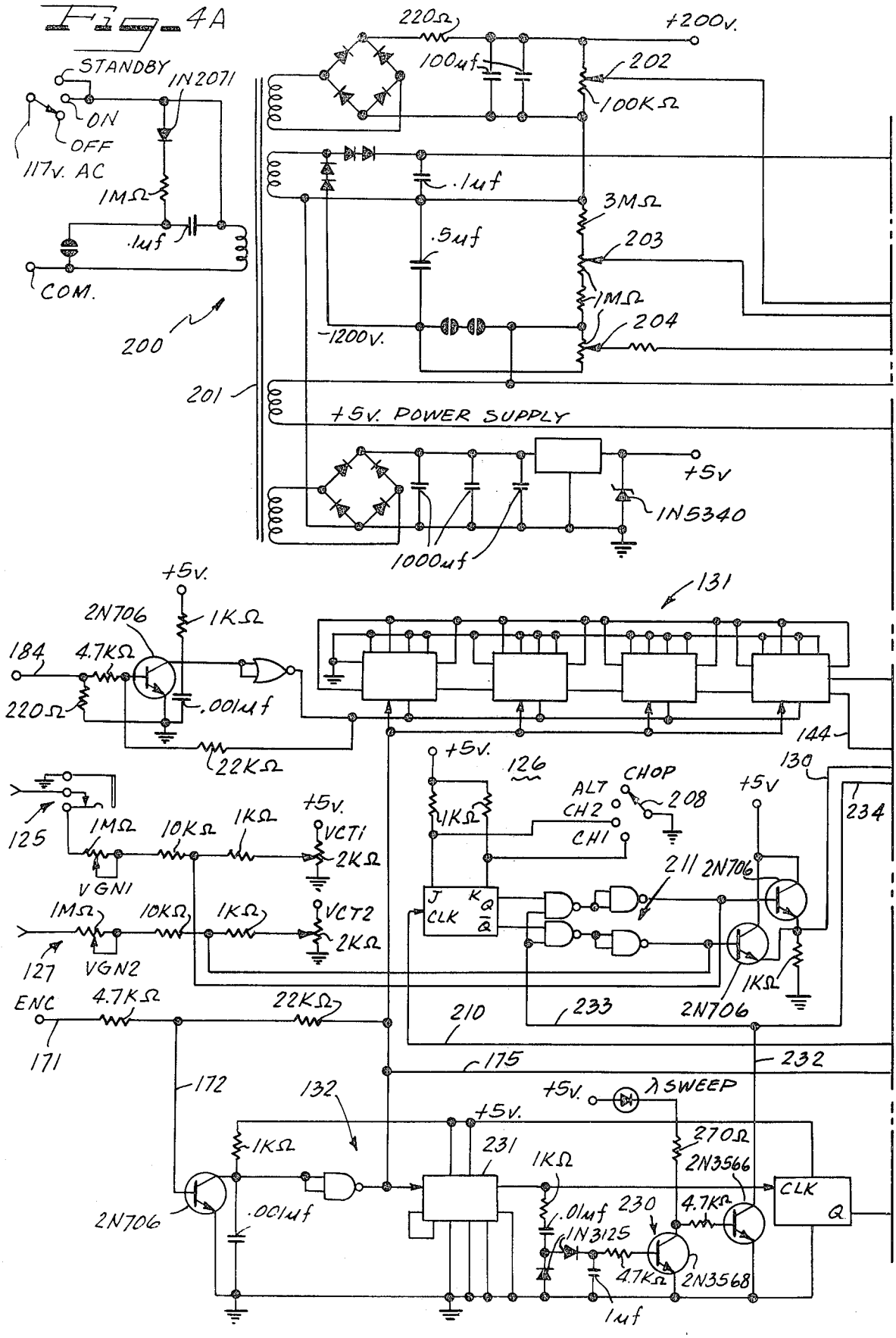

STANDBY
ON
OFF
117v. AC
1MΩ
.1μf
COM.
200
1N2071
220Ω
100μf
+200v.
202
100KΩ
.1μf
3MΩ
203
.5μf
1MΩ
204
-1200v.
201
+5v. POWER SUPPLY
+5v
1N5340
1000μf
+5v.
2N706
1KΩ
184
4.7KΩ
220Ω
.001μf
22KΩ
131
144
126
+5v.
1KΩ
ALT
CHOP
CH2
CHI
208
130
+5v
234
125
1MΩ
10KΩ
1KΩ
+5v.
VCT1
2KΩ
VGN1
211
2N706
J
CLK
K
Q
1MΩ
10KΩ
1KΩ
VCT2
2KΩ
127
VGN2
1KΩ
ENC
4.7KΩ
22KΩ
210
233
2N706
171
175
232
172
132
+5v.
λ SWEEP
+5v.
1KΩ
231
1KΩ
270Ω
2N3566
CLK
Q
2N706
.001μf
.01μf
230
4.7KΩ
1N3125
4.7KΩ
2N3568
1μf

Fig. 3

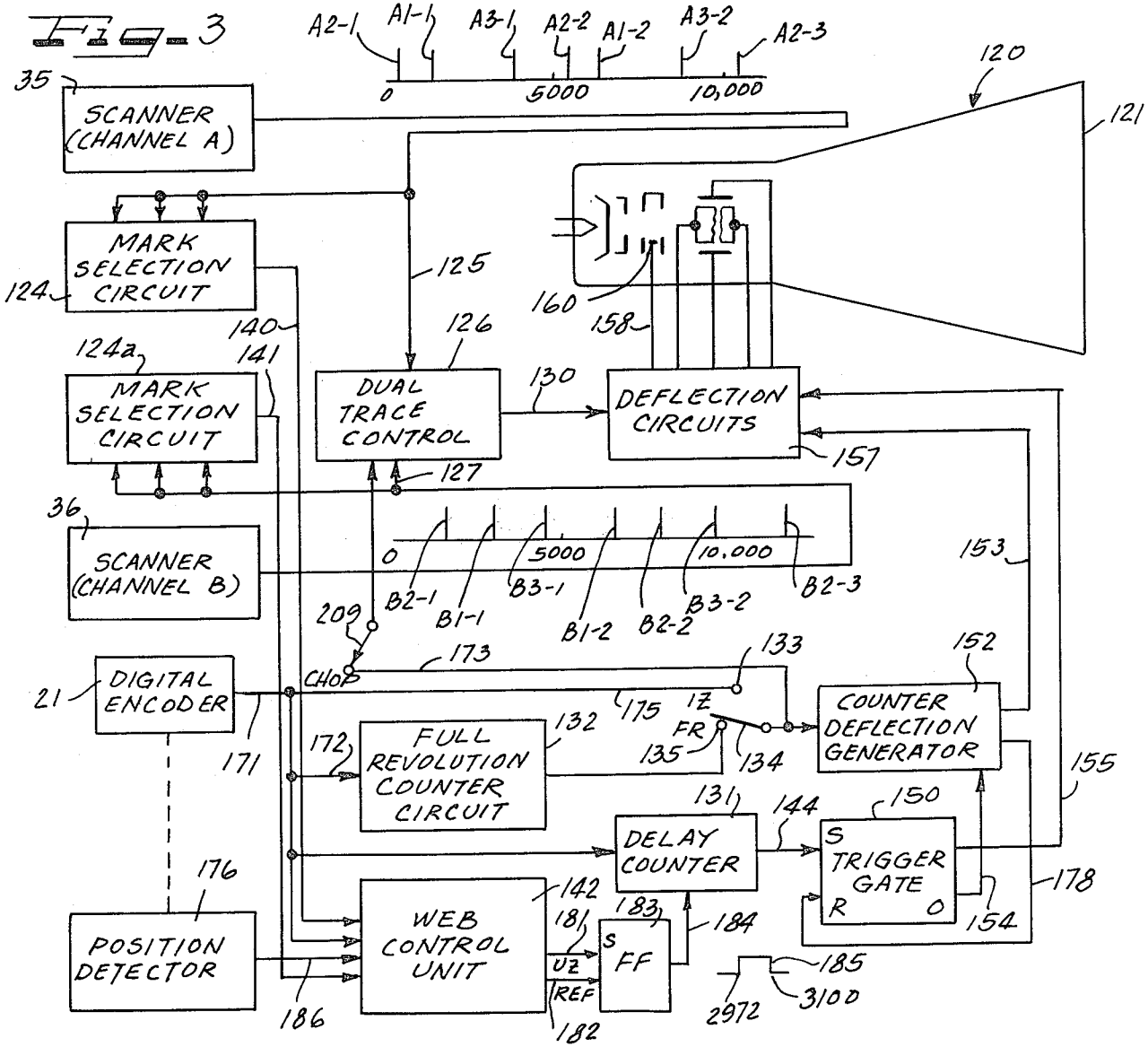
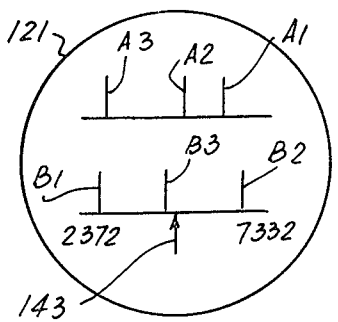


Fig. 3A



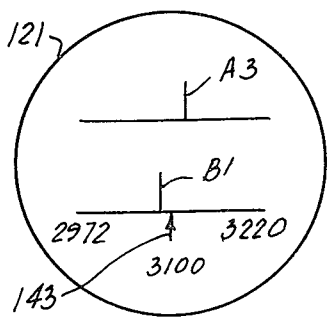
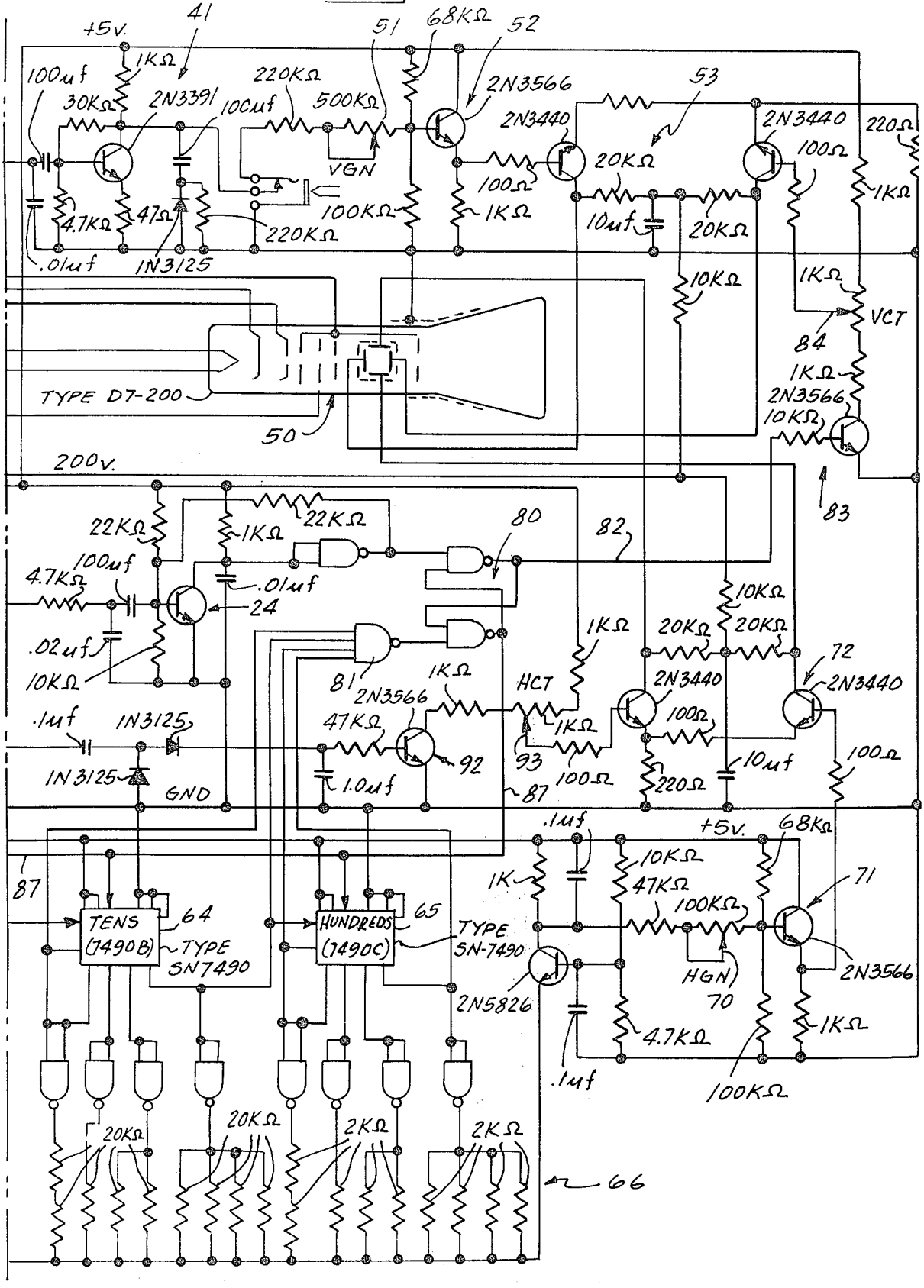


Fig. 3B

FIG 2B


+5v.
41
51
68KΩ
52
1KΩ
100μf
30KΩ
2N3391
10μf
220KΩ
500KΩ
2N3566
53
2N3440
2N3440
220Ω
100Ω
20KΩ
1KΩ
VGN
100Ω
1KΩ
10μf
20KΩ
4.7KΩ
47Ω
100KΩ
220KΩ
.01μf
1N3125
10KΩ
1KΩ
VCT
84
TYPE D7-200
50
1KΩ
2N3566
10KΩ
200v.
83
22KΩ
22KΩ
1KΩ
80
82
100μf
4.7KΩ
.01μf
24
10KΩ
.02μf
10KΩ
1KΩ
20KΩ
20KΩ
72
81
2N3566
1KΩ
HCT
2N3440
2N3440
.1μf
1N3125
47KΩ
1KΩ
100Ω
92
93
100Ω
10μf
100Ω
1N3125
GND
1.0μf
87
.1μf
+5v.
68KΩ
87
1K
10KΩ
47KΩ
100KΩ
71
TENS
(7490B)
64
TYPE
SN7490
HUNDREDS
(7490C)
65
TYPE
SN-7490
2N5826
HGN)
70
2N3566
4.7KΩ
1KΩ
.1μf
100KΩ
20KΩ
20KΩ
2KΩ
2KΩ
66

DISPLAY APPARATUS FOR A REGISTRATION CONTROL SYSTEM WHERE MOVEMENT IS REPRESENTED BY ENCODER PULSES

BACKGROUND OF THE INVENTION

In a registration control system, moving material either in the form of a web or in the form of discrete articles may have work applied thereto at a series of work stations along the path of movement. The work is to be applied cyclically at each station at repeat intervals on the material such that the work from succeeding stations is in register with the work previously applied. A typical example is in multicolor printing where different color inks are applied at successive stations on each repeat length along a moving web of sheet material. In such systems a scanner such as a photocell may be disposed to scan a margin of the moving material, for example, so as to sense the presence of marks in each repeat length which can be used to define a point of reference representing previously applied work for purposes of registration control. In such systems, a second point of reference is generated for representing the phase of the locally applied work. In some cases the local point of reference for each station may be generated in common where the work applying means at the respective stations in synchronized. For example, a position detector signal may be generated in each revolution of a device mechanically coupled with the work applying means as illustrated in my application for patent U.S. Ser. No. 256,727 filed May 25, 1972 (now U.S. Pat. No. 3,812,351 issued May 21, 1974) and incorporated herein by reference. In other instances, each work applying means may apply a local mark to the moving material to serve as a local point of reference, in which case two scanners may be required at a work applying station, one for sensing a previously applied mark, and one for sensing the locally applied mark, such a system being termed a "mark-to-mark" system.

In such registration control systems, display apparatus such as time base oscilloscopes with single or dual traces have been used to assist in locating suitable scanner signals for reference purposes. It is conceived that very important improvements can be made in such display equipment particularly in the ease and accuracy of operation thereof as part of a register control system.

SUMMARY OF THE INVENTION

This invention relates to display apparatus and particularly to a registration control system incorporating such display apparatus to facilitate set up.

It is a basic object of the present invention to provide a register control system including a scanner display apparatus of greatly improved accuracy and ease of operation, and which is reliably and economically integrated into the control system.

A feature of the invention resides in the provision of a register control including display apparatus having a deflection base measured in increments of motion rather than in time, and wherein full deflection may alternatively display essentially a complete repeat interval or essentially an inspection zone portion of the repeat interval.

Other objects, features and advantages of the invention will be readily apparent from the following detailed description taken in connection with the accompanying drawings, although variations and modifications may be effected without departing from the spirit and scope of the novel concepts of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic illustration of an exemplary register control system incorporating a single trace display apparatus in accordance with the present invention;

FIG. 1A is a diagrammatic illustration of scanner signals appearing on the display apparatus of FIG. 1 where full deflection represents a repeat length of the moving material;

FIG. 1B is a view similar to FIG. 1A but illustrating the scanner signal display where the circuitry of FIG. 1 is in a condition to illustrate an inspection zone portion of the repeat length during a full deflection of the display apparatus.

FIG. 2 consists of FIGS. 2A and 2B arranged as indicated and shows a detailed electric circuit diagram for an embodiment of register control system in accordance with FIG. 1;

FIG. 3 is a block diagram illustrating a mark-to-mark register control system including display apparatus of the dual trace type for simultaneously displaying signals on two scanner channels;

FIG. 3A is a diagrammatic illustration of the display by the system of FIG. 3 for the case where full deflection corresponds to a repeat length of the moving material;

FIG. 3B is a view similar to FIG. 3A but illustrating the case where an inspection zone portion of the repeat length is displayed during full deflection; and

FIG. 4 consists of FIGS. 4A and 4B arranged as indicated and is a detailed electric circuit diagram in accordance with the block diagram of FIG. 3.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Description of FIGS. 1, 1A and 1B

Referring to FIG. 1 there is illustrated a web 10 of moving material including web sections 10*a*, 10*b* and 10*c* located at respective work applying stations which may include work applying means such as diagrammatically indicated at 11, 12 and 13. Further details of a typical series of work applying stations are found in the first figure of U.S. Pat. No. 3,594,552 issued July 20, 1971. As illustrated in the second figure of said Pat. No. 3,594,552, marks may be applied to the web by the successive work applying means, for example in the opposite margins of the web. For the sake of illustration, FIG. 1 shows work applying means 11 as applying a series of marks in a first channel (channel A) such as the marks designated A1-1 and A1-2 on web section 10*c*, A1-11 and A1-12 on web section 10*b* and A1-21 and A1-22 on web section 10*a*. The web is indicated as moving in the direction of the arrow 14 under the impetus of a web drive 15. In the present embodiment, in conformity with the embodiment of said prior U.S. Pat. No. 3,594,552, the work applying means 11–13 are operated in synchronism with the web drive means 15. The work applying means 11–13 operate cyclically on successive repeat lengths of the web 10, the successive repeat lengths being defined by dash lines such as indicated at 17 on the web. For example, after the work applying operations at 11-13, the web may be severed at the successive dash lines 17 to form separate sheets. The same pattern of work will then be found on each

of the severed sheets. As illustrated in FIG. 1, each of the repeat lengths of the web 10 has one of the A1 marks thereon and the successive A1 marks are essentially at the same location in each of the successive repeat lengths of the web 10.

The work applying means 11 may also apply a second series of marks such as indicated at B1-1, B1-2, B1-11, B1-12, B1-21, and B1-22 at the successive repeat lengths of a second channel (channel B) on the web.

Similarly the work applying means 12 may apply marks such as indicated at A2-1, A2-2, A2-11, and A2-12 to channel A and such is indicated at B2-1, B2-2, B2-11, and B2-12 in channel B. Also, work applying means 13 may apply marks such as indicated at A3-1, A3-2, and B3-1, and B3-2 to each of the successive repeat lengths on the web.

It should be understood that the actual patterns applied to the web may include abrupt transitions or the like which are to be used as scanner marks, and that there may be extraneous marks on the web within the channels being scanned which are not suitable for control purposes.

For purposes of specific illustration, FIG. 1 shows a digital encoder 21 and an adjustable mark generator 22 mechanically coupled with the web drive 15 as indicated by dash lines 23 and 24 so that the digital encoder 21 and the mark generator 22 are operated in synchronism with the work applying means 11-13. By way of example, components 21 and 22 may make one complete revolution for each cycle of the work applying means 11-13 so that one revolution of components 21 and 22 represents a repeat length of the web 10. Digital encoder 21 may supply an encoder pulse for each increment of motion of the web 10, and for example may supply one thousand pulses during movement of a repeat length of the web through the web drive 15. The mark generator 22 may comprise a disk making one revolution during passage of a repeat length of the web, and having a mirror segment, for example, with an arcuate extent corresponding to 18°. As described in my aforementioned copending application Ser. No. 256,727 filed May 25, 1972, light reflected from the mirror segment may be received by means of a light pipe which is rotatably adjustable along the arcuate path of the mirror segment, so that a pulse of light is generated in each revolution of the mark generator at any selected timing relative to the cycles of the work applying means 11-13. The mark generator 22 supplies a square wave output pulse whose leading edge actuates trigger amplifier 24 so as to provide a suitable reference point with respect to the operation of each of the work applying means 11, 12 and 13 for purposes of registration control.

For purposes of diagrammatic illustration, a first work station associated with work applying means 11 is indicated as including scanners 31 and 32 for scanning channels A and B on the web, respectively. Similarly at the work stations associated with work applying means 12 and 13, scanners 33, 34 and 35, 36 have been indicated. As will be seen from the first figure of U.S. Pat. No. 3,594,552, the scanners may be located closely adjacent to the work applying means so as to represent the position of a previously applied pattern of work relative to such work applying means. The scanners may be located in advance of the associated work applying means for the case of a synchronized system such as illustrated in FIG. 1.

A selector switch is indicated at 40 for coupling any desired one of the photocells 31–36 with the input of a vertical pre-amplifier component 41. A second selector switch 42 is shown mechanically coupled with switch 40 as indicated by the dash line 43 so that the switches are manually set to a desired position jointly. For the illustrated embodiment, the mark generator pulse component 22 is the local reference point with respect to each of the scanner signals, and accordingly the output of mark generator component 22 is shown as being connected with the second, third, fourth, fifth, sixth and seventh positions of selector switch 42.

In accordance with the teachings of the present invention, a display apparatus is provided as part of the register control system of FIG. 1, and the horizontal deflection base for oscilloscope 50 is derived from the output of digital encoder 21 so that horizontal deflection is precisely synchronized with the motion of the web 10 regardless of any speed variations or the like. The scanner channel or location of interest is determined by selector switch 40 and in the illustrated embodiment it is supplied to the vertical deflection components 41, 51, 52 and 53 associated with oscilloscope 50. Thus, a mark suitable for control purposes will occur essentially at a uniform point in each repeat length, and will accordingly have a precisely determined location on the horizontal deflection axis of the oscilloscope display area as indicated at 55 in FIGS. 1A and 1B.

In the illustrated embodiment, encoder pulses from encoder component 21 are supplied to a units deflection counter stage 61 and to an inspection zone terminal (IZ) 62 of a selector switch 63. The output of encoder stage 61 is connected to a second terminal 64 of switch 63. Switch 63 controls the input to a tens deflection counter stage 64 whose output is connected to a hundreds deflection counter stage 65. The condition of the counter stages 61, 64 and 65 control a digital-to-analog converter component 66 which thus supplies a current to component 67 in accordance with the magnitude of the counts registered in stages 61, 64 and 65. The output of component 67 is supplied by components 70, 71 and 72 so as to control the horizontal deflection of the oscilloscope 50. Component 70 is a potentiometer for controlling the gain of the horizontal deflection circuit, while potentiometer 51 is used to control gain in the vertical deflection circuit.

The beginning of a counting cycle of the deflection counter is controlled by means of a trigger gate 80 having a set input connected to trigger amplifier 24 and having a reset input connected to NAND gate 81. When gate 80 is in reset condition, output 82 to blanking control 84 is at a level to activate the blanking circuit component 84 to prevent further display of signals on the oscilloscope 50. Potentiometer 84 serves to adjust the blanking signal to the desired level.

The reset output of gate 80 via conductor 87 is supplied to the reset input of stages 61, 64 and 65, and serves to hold the stages in a zero registering condition as long as gate 80 is reset. The pulse generated by trigger amplifier 24 at the leading edge of the mark generator signal from component 22 serves to actuate the set input of gate 80, shifting the gate to the set condition, and unblanking the oscilloscope 50 and allowing the deflection counter to begin a counting cycle.

With switch 63 in the position shown, the deflection counter counts to a count value of 990, at which time

gate 81 is actuated to reset trigger gate 80. during the counting to 990 by the deflection counter, the beam of oscilloscope 50 is progressively deflected along its horizontal axis from left to right as viewed in FIG. 1A. If the point corresponding to the leading edge of the mark generator signal from component 22 is considered to represent a zero degree position of mark generator 22, then the beam will be deflected along the horizontal axis approximately to a point representing 360° of rotation of mark generator 22 from such initial position. For example, if one thousand encoder pulses are generated in a complete revolution of mark generator 22, then the deflection from the zero degree position to the 360° position as shown in FIG. 1A will correspond to one thousand encoder pulses, and the actual horizontal trace on the display area 55 in FIG. 1A would terminate at 99 percent of a complete revolution, i.e. at 356.4°. Thus, in the illustrated position of switch 63, essentially a complete repeat length on the web corresponding to 360° of rotation of mark generator 22 is displayed as indicated in FIG. 1A.

If now switch 63 is shifted to its upper inspection zone condition, the deflection counter will count by tens since encoder pulses are supplied directly to counter stage 64. Thus, each encoder pulse will cause 10 times the amount of deflection by the oscilloscope beam, and the oscilloscope will have a display as indicated in FIG. 1B. Specifically, if zero degrees is applied to the left hand side of the trace corresponding to the beginning of the mark generator signal from component 22, then the end of the trace at the right hand side of the display area will correspond to approximately 36° of rotation of mark generator component 22, or 10 percent of the repeat length of the web 10.

Referring to FIG. 1A, it will be observed that the marks such as B2-1 in the successive repeat lengths produce pulses B2 on display area 55 at approximately a 60° position. In order for such a pulse to appear on the enlarged display scale of FIG. 1B, it is necessary to shift the phase of the mark generator signal from component 22. This is accomplished by means of a motor driving a light pipe angularly relative to the path of the mirror segment previously referred to, and as disclosed in the aforesaid application Ser. No. 256,727. Thus, by actuating a manual push button 90, the motor of mark generator component 22 may be energized to advance the phase of the mark generator signal until pulse B2 appears on the display area 55 as shown in FIG. 1B.

In order to protect the oscilloscope from an unduly low horizontal deflection rate, the encoder pulse rate is supplied by a conductor 91 to a go down circuit 92 which controls the horizontal deflection circuit 72 via an adjustment potentiometer 93.

Description of FIG. 2

FIG. 2 shows a detailed electric circuit diagram in accordance with the block diagram of FIG. 1, and the same reference numerals have been applied to corresponding parts in FIG. 2. Accordingly, the operation of FIG. 2 will be apparent from the preceding description with respect to FIG. 1.

There is additionally shown in FIG. 2, a power supply 100 including a power transformer 101 and circuitry for supplying direct current voltages and filament voltage to the system. Potentiometer 102 provides a focus adjustment for the oscilloscope 50, potentiometer 103 provides an adjustment for astigmatism, and potentiometer 104 provides an adjustment for beam intensity.

Conductor 106 shown at the lower left in FIG. 2 is connected to receive encoder pulses for example from digital encoder component 21, FIG. 1.

Summary of Operation of FIGS. 1 and 2

In operation of the system, selector 40 is adjusted to a position so as to be connected with a scanner whose output is to be observed. For example, in the position of selector 40 shown in FIG. 1, the output of scanner 36 associated with channel B on the web 10 is supplied to the vertical deflection circuit of oscilloscope 50. At the same time selector 42 is correspondingly positioned so as to provide a suitable reference point. For the case where the work applying means 13 is synchronized with a web drive 15, a mark generator component 22 may supply a mark generator signal in each revolution thereof, and the leading edge of this mark generator signal may provide a suitable pulse from trigger amplifier 24 so as to initiate a deflection cycle of oscilloscope 50. Further, by way of example, each revolution of the mark generator component 22 may cause the generation of a predetermined number of uniformly spaced encoder pulses by means of a digital encoder component 21 rotating in synchronism with the mark generator 22. For example, an encoder pulse may be generated in response to each uniform increment of movement of the web 10 such as the movement of 0.01 inch. A thousand encoder pulses may be generated during each revolution of mark generator component 22 so that the one thousand encoder pulses represents a repeat length of the web 10.

Horizontal deflection of the oscilloscope 50 is produced by supplying the encoder pulses from component 21 to a deflection counter comprising counter stages 61, 64 and 65 which has an associated digital-to-analog converter 66 connected with the horizontal deflection circuit of the oscilloscope 50. Thus, referring to the display area 55 of the oscilloscope 50 as indicated in FIG. 1A, each encoder pulse will result in a uniform increment of horizontal deflection, with approximately one thousand encoder pulses producing full deflection.

In order to insure resetting of the deflection counters 61, 64 and 65 in each cycle, it is advantageous to provide for resetting of trigger gate 80 at a count less than one thousand, for example, 990. In this way, even if an encoder pulse is missed by the counter chain, trigger gate 80 will still be reset in advance of the occurrence of the next mark generator pulse from component 22. Thus, if 360° of horizontal deflection represents a repeat length on web 10 and corresponds to one thousand encoder pulses, full deflection of 990 encoder pulses will represent 99 percent of 360° or 356.4°. For practical purposes, therefore, the display area of FIG. 1A will represent the condition of the successive repeat lengths of the web substantially in their entirety. The persistence of the fluorescent material of the display area 55 will be correlated with the anticipated minimum encoder rate, so that signals occurring at uniform positions in the successive repeat lengths of the web will be displayed without unacceptable flicker. The go down circuit 92 may operate to remove the oscilloscope beam from the fluorescent material of the display area 55 when the encoder pulse rate is low enough either to endanger the fluorescent material, or to produce an undesired degree of flicker of the display.

Description of FIGS. 3, 3A, and 3B

FIG. 3 illustrates a register control system including a dual trace oscilloscope 120 having a display area as indicated at 121 in FIGS. 3A and 3B wherein two different scanner channels such as channels A and B on the web 10 of FIG. 1 are displayed.

For the sake of a specific illustration in FIG. 3, scanner 35 of FIG. 1 has been shown as being connected with a mark selection circuit 124 which may conform with that of U.S. Pat. No. 3,624,359 issued Nov. 30, 1971. Further, by way of example, the output of scanner 35 is connected to an input jack 125 of dual trace control 126, while scanner 36 of FIG. 1 is shown as being connected to a second input jack 127 of dual trace control 126.

The digital encoder component 21 of FIG. 1 may supply encoder pulses to the dual trace control 126 so as to multiplex the two inputs 125 and 127 onto a common output 130 controlling vertical deflection signals with respect to the two traces in time sequence. Encoder pulses may also be supplied to a delay counter 131, a full revolution counter 132 and to terminal 133 of a switch 134. As in the previous embodiment switch 134 in the lower position provides for display of substantially a complete repeat length interval on the web while in the upper position full deflection conforms with an inspection zone portion of the repeat length.

By way of example, the mark selector circuit 124 may be set to select the second occurring pulse in each repeat cycle as produced by passage of mark A1 under scanner 35 in FIG. 1. Thus, output line 140 from mark selector circuit 124 may supply a square wave pulse such as produced by the "one shot" component of the second Figure of U.S. Pat. No. 3,624,359 having reference numeral ninety-one. This pulse be termed the "lead" pulse and represent a point of reference relative to a previously applied pattern on the web or relative to the work applied to the web by the local work applying means. By way of example, a second mark selection circuit 124*a* may provide a lag pulse on a second conductor 141 which represents the output from a one shot having reference numeral ninety-two in the second figure of Patent 3,624,359. Web control circuit component 142 of FIG. 3 may conform with component ninety of the second figure of U.S. Pat. No. 3,614,359. Accordingly in accordance with the description in the third column of Pat. No. 3,624,359, component 142 may correspond to the circuitry illustrated in application Ser. No. 722,095 filed Apr. 17, 1968 (now U.S. Pat. No. 3,594,552 issued July 20, 1971). In circuitry such as represented by component 142, a lead pulse such as occurs on conductor 140 initiates a counting cycle. When the counting chain reaches a predetermined count of encoder pulses, a so called inspection zone unit zero pulse designated UZ in U.S. Pat. No. 3,594,552 is produced initiating a condition of the circuitry such that a scannerpulse thereafter appearing in an inspection zone interval will serve as a point of reference in determining a registration condition. Thus, in setting up such a system, it is desired to observe scanner pulses which would incur during the inspection zone interval in the operation of the circuit 142. Accordingly, delay counter 131 is set to a count value such that the midpoint of the inspection zone of circuitry 142 will coincide with the midpoint of the display area 121 as indicated at 143 in FIGS. 3A and 3B. If the inspection zone corresponds to 256 encoder pulses, delay counter 131 would be set to emit an output at conductor 144 after reaching a count value such that 128 pulses later, the beam will be a midpoint 143 in FIG. 3B. The output of delay counter 131 is utilized to set trigger gate 150 so as to initiate a counting cycle of the counter deflection generator component 152. This component 152 includes a digital-to-analog converter so as to provide a suitable analog output signal at output line 153 for controlling horizontal deflection of oscilloscope 120.

The trigger gate 150, in addition to an output conductor 154 leading to the reset control of deflection generator 152, has an output conductor 155 leading to the deflection circuit component 157 for producing a blanking signal. The output blanking signal from the component 157 is supplied via conductor 158 to a blanking electrode 160 of oscilloscope 120.

During a full repeat length display as indicated in FIG. 3A, encoder pulses from encoder component 21 are supplied via conductors 171 and 172 to a full revolution counter circuit 132. By way of example, this circuit may serve to divide the input encoder pulse rate by a factor of twenty, the reduced encoder pulse rate being supplied via terminal 135 and switch 134 to a conductor 173 leading to the dual trace control circuit 126. Under these circumstances, multiplexing of the scanner inputs supplied at 125 and 127 takes place at one -twentieth of the encoder pulse rate.

In the upper position of switch 134 which produces the enlarged horizontal deflection scale as indicated in FIG. 3B, the encoder pulse rate is supplied via conductors such as indicated at 171 and 175 and via switch 134 (in its upper position) to conductor 173 and the dual trace control circuit 126 so that multiplexing takes place in response to the full pulse rate.

For the sake of a definite example with respect to FIG. 3A, assume that the A2 marks such as A2-1 occur at an encoder pulse count of three hundred after the beginning of a repeat length, and that the A1 marks occur at an encoder count of 1250, and that the A3 marks occur at an encoder count of 3150. Also assume that the B2 marks occur at an encoder count of 1600, the B1 marks at an encoder count of 3000, and the B3 marks at an encoder count of 4500. Further, assume that the repeat length corresponds to five thousand encoder pulses, If position detector 176 supplied a pulse at the beginning of each repeat length, and if the inspection zero pulse will occur at conductor 144 at the output of delay counter 131 at a count 2372, for example, then the pulses will appear in the order indicated in FIG. 3A on display area 121.

By way of example, with the switch 134 in the position shown, a reset signal may appear at conductor 178 leading to the reset input of trigger gate 150 at a total count of 4960. Thus, the horizontal traces shown in FIG. 3A may extend from an encoder count of 2372 to an encoder count of 2372 plus 4960, or a total count of 7332. Referring to FIG. 3A, it will be observed that the first pulse displayed is the B1 pulse which is due to scanner pulse B1-1 from scanner 36, FIG. 3, located an encoder count of 3000. Since the horizontal traces in FIG. 3A begin at an encoder count of 2372, the position of pulse B1 in FIG. 3A corresponds to a horizontal deflection of 3000 minus 2372 or 628 encoder pulses. If the inspection zone of the web control circuit 142 corresponds to 256 encoder pulses, then neither pulse

B1, nor the subsequently occurring pulses in each display cycle, namely pulses A3, B3, A2, A1 and B2 in FIG. 3A will lie within the inspection zone of web control circuit 142.

If under these circumstances, switch 134 were placed in the upper position, encoder pulses would be supplied via conductors 171 and 175 to the input of counter deflection generator 152, so that each encoder pulse would produce twenty times the amount of deflection as illustrated in FIG. 3A. If now, conductor 178 is actuated at a count of 248, for example, as registered in the countergenerator 152, a full deflection of the oscilloscope 120 would correspond to 248 encoder pulses. Thus, the full deflection of the oscilloscope 120 would correspond essentially to the inspection zone of 256 encoder pulses of web control circuit 142. Since deflection would again begin at 2372 encoder pulses after the occurrence of a position detector pulse from position detector 176, the horizontal deflection would cover a range of encoder pulse numbers from 2372, to 2372 plus 248, or 2620, and the horizontal trace would achieve full deflection at an encoder count corresponding to 2620 on the scale of FIG. 1, and thus would terminate prior to scanning of mark B1-1 which occurs at an encoder count of 3000. Accordingly, where the inspection zero pulse occurs at 2372, the display corresponding to that shown in FIG. 3B would not show any pulses in either A or B trace.

On the other hand, if the delay counter 131 provides an inspection zone zero pulse at an encoder count of 2972 after the occurrence of a position detector pulse from component 176, then pulses B1 and A3 would appear on the display as shown in FIg. 3B.

From the display as shown in FIG. 3B, the operator could conclude that the web control circuit 142 would operate properly with the mark selection circuit 124 arranged to transmit the A3 pulses resulting from the A3 marks of FIG. 1 to control circuit 142 and with the second mark selection circuit 124a set to transmit the B1 pulses via conductor 141 to the control circuit 142.

For the sake of the specific illustration in FIG. 3B, it is assumed in FIG. 3 that the web control circuit 142 conforms with that of U.S. Pat. No. 3,594,552 and supplies a unit zero pulse (UZ) to conductor 181 at an encoder to count of 2972 and supplies a reference pulse (REF) to conductor 182 at the midpoint of the inspection zone and at a count of 2972 plus 128 or 3100. Thus flip-flop 183 supplies an output rectangular pulse to conductor 184 as indicated at 185, the leading edge of the pulse occurring at a count of 2972 after the position detector pulse at input 186, and the trailing edge occurring at an encoder count of 3100. At the trailing edge of pulse 185, delay counter 131 begins counting, and after then counting 4872 encoder pulses, emits the inspection zone zero signal at output 144. This occurs at an absolute encoder count of 3100 plus 4872 or 7972 pulses. In the second repeat cycle an absolute count of 7972 pulses occurs at 2972 pulses from the second position detector pulse and thus occurs at the beginning of the inspection zone of circuit 142 in the second cycle. This is the desired operation to produce the display indicated in FIG. 3B.

Description of FIG. 4

The circuitry of FIG. 4 shows a detailed implementation of the block diagram of FIG. 3, and the same reference numerals have been applied to corresponding parts in FIG. 3 and 4.

In FIG. 4 a power supply is indicated at 200 including a transformer 201 for supplying direct current and filament votages to the system. Potentiometer 202 adjust for astigmatism, potentiometer 203 represents a focus adjustment, and potentiometer 204 is for the purpose of controlling beam intensity. A switch 205 may be mechanically coupled with switch 134 and is shown as having a lower inspection zone (IZ) position and an upper full revolution (FR) position, in conformity with the upper and lower positions of switch 134, respectively. Two mechanically coupled selector switches 208 and 209 are shown as having successive positions labeled "chop", "alt", "Ch 2" and "Ch 1". In the "chop" position the circuit of FIG. 4 conforms with the block diagram of FIG. 3, and each pulse supplied via switch 134, conductor 173, switches 209, and conductor 210 serves to shift the condition of the chopper circuit 211 of dual trace control section 126.

In the alt or alternate position of switches 208 and 209, chopper 211 is switched in response to each inspection zone zero pulse supplied to output conductor 212 leading to switch 209.

In the Ch 2 position of switches 208 and 209, scanner input channel 127 is continuously enabled, and signals from this channel are supplied via output conductor 130 for display means of the lower trace of oscilloscope 120. Similarly in the Ch 1 position of switches 208 and 209, the input channel associated with jack 125 is enabled and signals from this channel are transmitted to the common output line 130 for display by means of the upper trace of oscilloscope 120.

As shown in the lower right in FIG. 4, counter deflection generator circuit 152 includes a NAND gate 220 which provides an output when counter stages 221 and 222 of generator 152 register a count of 248.

A go down circuit is indicated at 230 as part of the full revolution counter circuit 132, this circuit responding to the encoder pulse rate as divided by a decade counter stage 231. When the encoder pulse rate is at an unduly low value, chopper 211 is disabled by means of output conductors 232 and 233 of go down circuit 230, and trigger gate 150 is held in the reset condition by means of output conductors 232 and 234.

With the foregoing description, taken in connection with the description of FIGS. 1-3, the operation of the circuit of FIG. 4 will be apparent.

Summary of Operation of FIGS. 3 and 4

With a mark-to-mark register control system such as represented at 124 and 142 in FIG. 3 and as described in the prior U.S. Pat. No. 3,624,359, it may be desired to simultaneously display signals from two scanner channels such as channels A and B shown in FIG. 1. For example, it may be desired to connect scanner 35, FIG. 1, to the mark selection circuit 124 and also to input jack 125 of dual trace control 126, FIG. 3. Further, it may be desired to connect the output of scanner 36, FIGS. 1 and 3, to a second input 127 of the dual trace control circuit 126, whereupon the signals due to marks on channels A and B of FIG. 1 will be displayed

on the respective traces of oscilloscope **120** as indicated in FIG. 3A.

As previously explained in detail, delay counter **131** will begin the horizontal deflection of oscilloscope **120** after the occurrence of a reference pulse representint the midpoint of the inspection zone of web control circuit **142.** This reference pulse at conductor **182** produces the trailing edge of the rectangular pulse waveform **185** on the counter control input **184** of delay counter **131.** The delay count of counter **131** is selected to initiate scanning of oscilloscope **120** at the beginning of the next inspection zone of web control circuit **142.**

As in the preceeding embodiment, with the switch **134** in the full revolution (FR) position, a full deflection of the oscilloscope **120** corresponds essentially to a repeat length on the web **10** of FIG. **1,** while with the switch **134** in the inspection zone position (IZ), a full deflection of the oscilloscope **120** takes place during the occurrence of a number of encoder pulses corresponding to the duration of the inspection zone of the web control circuit **142.** For example, where a repeat length corresponds to five thousand encoder pulses, full deflection along the horizontal axis in FIG. 3A may take place in response to **4960** encoder pulses. For the case of FIG. 3B, where the inspection zone corresponds to **256** encoder pulses, full horizontal deflection may take place in response to **248** encoder pulses, for example. Further, in FIG. 3B, midpoint **143** on the trace will correspond to the midpoint of the inspection zone of web control circuit **142** to greatly facilitate the interpretation of the display of FIG. 3B.

The exact operation of the web control circuit **142** is not critical to an understanding of the concepts of the present invention. A preferred mode of operation, however, differs from that referred to in U.S. Pat. No. 3,624,359, in that position detector pulses from position detector **176** initiate each counting cycle. In this case, the scanner pulses supplied by lines **140** and **141,** such as pulses A3 and B1, may be desired to be in time coincidence, and the control circuit **142** may be operated to maintain such time coincidence. Accordingly, it is very desirable to observe the raw scanner pulses as in FIG. 3B, so as to be able to select marks which are safely within the inspection zone.

The web control circuit may delay pulses on line **140** by a fixed encoder count, and have an adjustable counter for adjusting the pulses on line **141** so as to be in exact time coincidence with such delayed pulses due to input **140.**

Referring to the terminology of the claims, it will be observed that the pulse from trigger amplifier **24** in FIG. **1** may be termed a reference pulse marking the beginning of each cycle at the work applying stations **11-13.** The signal from scanner **36,** FIG. **1,** for example, may be termed a scanner pulse generated at the work applying station corresponding to work applying means **13.** By way of example, scanner **36** may supply a B2 scanner pulse due to the B2 marks of FIG. **1** and such B2 scanner pulses will represent the point of application of work to the web **10** at the station associated with work applying means **12.** The reference pulse at the output of trigger amplifier **24** serves to initiate a counting cycle of the counter deflection generator comprising components **61, 64, 65** and **66,** in FIG. **1.** Thus, the counter deflection generator has a counter cycle control input comprising the set input of trigger gate **80** which is responsive to a reference pulse from trigger amplifier **24** to initiate a counting cycle.

With switch **63** in its lower position, the deflection generator of FIG. **1** has a first counting condition wherein a given maximum deflection along the horizontal axis produces a display as indicated in FIG. 1A. With switch **63** in its upper position, the deflection generator has a second counting condition wherein maximum deflection along the horizontal deflection axis is produced in response to counting of a number of encoder pulses equal to a fraction, (such as one tenth), the number of encoder pulses corresponding to maximum deflection in the first counting condition. Thus, switch **63** in its upper position serves to display a selected scanner pulse such as the B2 pulse on an enlarged scale on the display screen **55** as indicated in FIG. 1B.

Similarly in the embodiment of FIGS. **3** and **4,** the output of delay counter **131** at conductor **144** may be termed a reference pulse. For example, if position detector **176** initiates a predetermined counting cycle of the control circuit **142,** then the reference pulse at output **144** can be considered to mark the beginning of a cycle of the work applying stations associated with work applying means **11-13.** The pulse B3 due to the B3 marks of FIG. **1,** for example, may be considered a scanner pulse generated at the work applying station associated with work applying means **13** to represent the point of application of the work to the web section **10***c*. The counter deflection generator **152** of FIG. **3** has a counter cycle control input in the form of trigger gate **150** and conductor **154** which initiates a counting cycle of the deflection generator in response to the occurrence of the reference pulse at output conductor **144** of delay counter **131.**

The NAND gate **81,** FIG. **1,** constitutes a gate circuit having an input connected to the deflection generator represented by component **61, 64, 65** and **66** in FIG. **1** and having an output connected to blanking circuit **83,** 84 (via trigger gate **80**) so as to supply a blanking signal to oscilloscope **50** in response to a count value of **99** in the counter stages **64** and **65.** In the lower position of switch **63,** gate **81** is actuated after the occurrence of **990** encoder pulses, while in the upper positions of switch **63,** gate **81** is actuated after the occurrence of 99 encoder pulses.

In FIG. **4,** gate circuit **220** shown at the lower right is actuated after the occurrence of 4960 encoder pulses for the lower position of switch **134,** and after the occurrence of **248** encoder pulses for the upper position of switch **134.**

It will be apparent that many modifications and variations may be effected without departing from the scope of the novel concepts of the present invention.

I claim as my invention:

1. In a system for controlling the cyclical application of work at successive work applying stations to a moving work receiving material at repeat intervals and such that the work applied at the successive stations has a desired registration condition and wherein a reference pulse is generated to mark the beginning of each cycle at a work applying station and a scanner pulse is generated at each work applying station in each cycle to represent the point of application of the work to the work receiving material at such station, apparatus for displaying such scanner pulses to facilitate set up, comprising

a display device having a display screen and having first and second deflection means for controlling deflection along respective first and second coordinate axes on said display screen, said second deflection means being connectable to receive said scanner pulses during set up of the system,

encoder means for coupling with work receiving material for generating encoder pulses as a function of successive increments of movement thereof to subdivide the repeat intervals,

a counter deflection generator having a counter input connected to said encoder means for counting of encoder pulses and having an output connected with said first deflection means for producing uniform deflection along said first coordinate axis of the display screen as a function of movement of said work receiving material, and having a counter cycle control input for initiating a counting cycle of said deflection generator and responsive to a reference pulse marking the beginning of a cycle at a work applying station to initiate a counting cycle of the deflection generator,

said deflection generator having a first counting condition wherein a given maximum deflection along the first deflection axis is produced in response to counting of a first number of encoder pulses corresponding to at least a substantial proportion of a repeat interval between successive applications of work at a work applying station and having a second counting condition wherein such given maximum deflection along said first deflection axis is produced in response to counting of a second number of encoder pulses equal to a fraction of said first number, and

switch means connected with said deflection generator and operable to selectively place said deflection generator in said first counting condition to display substantially all of the scanner pulses occurring during successive repeat intervals and thereby to facilitate selection of a desired scanner pulse and in said second counting condition to display a scanner pulse occurring in a selected portion of successive repeat intervals, whereby the system can be adjusted to display a selected scanner pulse on an enlarged scale on said display screen.

2. In a system according to claim **1**,

a blanking circuit connected with said display device and operable in response to a blanking signal to prevent the display of scanner pulses supplied to said second deflection means, and

a gate circuit having an input connected to said deflection generator and an output connected to said blanking circuit and operable in response to count values attained by said deflection generator in said first and second counting conditions thereof to supply said blanking signal to said display.

3. In a system according to claim **2**, said deflection generator in said first counting condition having a series of counting stages including a first counting stage and second counting stages, and in said second counting condition including said second counting stages but excluding said first counting stage, and said gate circuit being responsive to a common condition of the second counting stages only in the first and second counting conditions of said deflection generator to produce said blanking signal, so as to emit the blanking signal in the second condition of the deflection generator regardless of the count value registered by the first counting stage.

4. In a system according to claim **1**, said display device having first and second separate display areas on said display region and having respective second deflection means for controlling deflection relative to second coordinate axes with respect to the first and second display areas, respectively, and said first deflection means conjointly controlling deflection relative to first coordinate axes of both of said display areas to produce a common scale for both display areas, and first and second scanner means connected with the respective second deflection means to provide for display of first scanner signals from the first scanner means on the first display area and for display of second scanner signals from the second scanner means on the second display area concurrently and on a common scale with respect to the first coordinate axis of said display region.

5. In a system for controlling the cyclical application of work at successive work applying stations to a moving web at repeat lengths along the web such that the work applied at the successive stations has a desired registration condition and wherein a reference pulse is generated in each cycle of operation at a work applying station, and wherein an inspection zone is defined in relation to such reference pulse and corresponds to the range of permissible registration error, and wherein scanner pulses are generated at each work applying station in each cycle of operation as a function of the instantaneous position of the web relative to such station, apparatus for displaying such scanner pulses to facilitate selection of a scanner pulse to occur within said inspection zone during set up, and comprising

a display device having a display screen and having horizontal and vertical deflection means for controlling deflection along respective horizontal and vertical coordinate axes on said display screen, said vertical deflection means being connectable to receive said scanner pulses during set up of the system,

encoder means for coupling with the movement of the web for generating encoder pulses as a function of successive increments of movement thereof and thus to incrementally subdivide each repeat length of the web,

a counter deflection generator having a counter with a counter input connected to said encoder means for counting of encoder pulses, and having an output connected with said horizontal deflection means for producing uniform deflection along said horizontal coordinate axis of the display screen in step with the movement of said web,

said deflection generator having a first counting condition wherein a given maximum deflection along the horizontal deflection axis is produced in response to counting of a first number of encoder pulses corresponding to at least a substantial proportion of a repeat length between successive applications of work at a work applying station and having a second counting condition wherein such given maximum deflection along said horizontal deflection axis is produced in response to counting of a second number of encoder pulses equal to a fraction of said first number and substantially corresponding to the extent of said inspection zone,

means connected with said deflection generator and operable to selectively place said deflection generator in said first counting condition to display sub-

stantially all of the scanner pulses occurring during successive repeat intervals and thereby to facilitate selection of a desired scanner pulse and operable to place said deflection generator in said second counting condition to display scanner pulses occurring in a selected portion of successive repeat intervals substantially corresponding to the extent of said inspection zone, whereby the system can be adjusted to display essentially only those scanner pulses occurring within the inspection zone, and

means responsive to the encoder pulses and to the reference pulses and automatically operable in the second counting condition to initiate deflection relative to said horizontal coordinate axis such that the midpoint of the inspection zone essentially coincides with the midpoint along said horizontal coordinate axis.

6. In a system according to claim **5**,

a blanking circuit connected with said display device and operable in response to a blanking signal to prevent the display of scanner pulses supplied to said vertical deflection means, and

a gate circuit having an input connected to said counter of said deflection generator and having an output connected to said blanking circuit and operable in response to respective first and second predetermined count values attained by said counter of said deflection generator in said first and second counting conditions thereof to control the supply of said blanking signal to said display, said first predetermined count value being less than the number of encoder pulses in a repeat length to insure that said gate circuit resets said counter of said deflection generator to an initial count value in said first counting condition.

7. In a system according to claim **6**, said counter of said deflection generator in said first counting condition having a series of counting stages including a first counting stage and second counting stages, and in said second counting condition including said second counting stages but excluding said first counting stage, and said gate circuit being responsive to a common count condition of the second counting stages in the first and second counting conditions of said counter of said deflection generator to produce said blanking signal, so as to emit the blanking signal in the second counting condition of the deflection generator regardless of the count value registered by the first counting stage, the common count condition of said second counting stages representing a count value corresponding approximately to the number of encoder pulses equal to the inspection zone.

8. In a system according to claim **5**, said display device having first and second separate display areas on said display region and having respective vertical deflection means for controlling deflection relative to vertical coordinate axes with respect to the first and second display areas, respectively, and said horizontal deflection means conjointly controlling deflection relative to horizontal coordinate axes of both of said display areas to produce a common scale for both display areas, and first and second scanner means connected with the respective vertical deflection means to provide for display of first scanner signals from the first scanner means on the first display area and for display of second scanner signals from the second scanner means on the second display area concurrently and on a common scale with respect to the horizontal coordinate axis of said display region which is keyed to the individual increments of movement of the web.

9. In a web system where set up is effected by selecting suitable marks applied to the web at successive printing stations and wherein the system is operable to generate a substantial number of uniform encoder pulses in each printing cycle such that each encoder pulse represents a uniform individual increment of movement of the web corresponding to a fraction of a repeat length of the printed web, and to generate a reference pulse to represent a predetermined point in each repeat cycle during continuous movement of the web during a set up operation, and wherein the web system is operable to provide an inspection zone generally representing the range of permissible phase values for a selected scanner pulse and wherein the midpoint of the inspection zone is to occur a predetermined number of encoder pulses after the beginning of an inspection zone, apparatus for displaying such scanner pulses to facilitate selection of a scanner pulse during set up of the system, said apparatus comprising

a display device having a display screen and having first and second deflection means for controlling deflection along respective first and second coordinate axes on said display screen, said second deflection means being connectable to receive said scanner pulses during set up of the system,

a counter deflection generator responsive to encoder pulses and operable in a first counting condition to control said first deflection means to display at least a substantial proportion of a repeat length of the web, and operable in a second counting condition to control said first deflection means to display essentially only a fraction of the repeat length corresponding to the length of the inspection zone, and

delay counter means controlling said display device and responsive to said reference pulse to initiate display of scanner pulses in the second counting condition in each repeat cycle such that the midpoint of the inspection zone will always occur substantially at a predetermined point on said display screen.

10. In a system according to claim **9**, said delay counter means introducing a delaying count of encoder pulses equal to the total number of encoder pulses in a repeat length less said predetermined number of encoder pulses such that display is initiated in the first and second counting conditions substantially at the beginning of the inspection zone, and such that the midpoint of the inspection zone corresponds substantially to a midpoint with respect to the first coordinate axis in said second counting condition.

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