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Dobson et al.

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[45] **July 17, 1973**

[54] **INTERVALOMETER FOR PARACHUTE FLARE LAUNCHER**

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[52] **U.S. Cl.** **89/28,** 89/1.814, 102/374

[51] **Int. Cl.** **F41f 3/04,** F41f 13/08

[58] **Field of Search** 89/28, 1.814; 102/37.4

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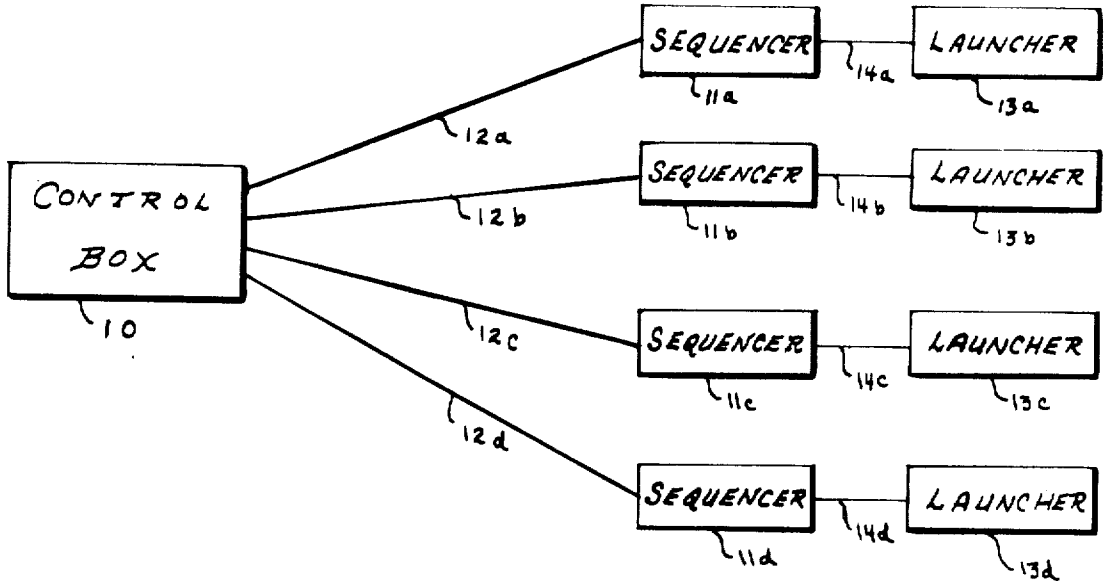
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Primary Examiner—Benjamin A. Borchelt
Assistant Examiner—J. V. Doramus
Attorney—Harry A. Herbert, Jr. et al.

[57] **ABSTRACT**

A control apparatus for automatically launching parachute flares from launchers which may be positioned in various different locations. The control apparatus which is located at a distance from the launchers contains the firing, timing and safety circuits necessary to launch the parachute flares in sequence.

4 Claims, 11 Drawing Figures



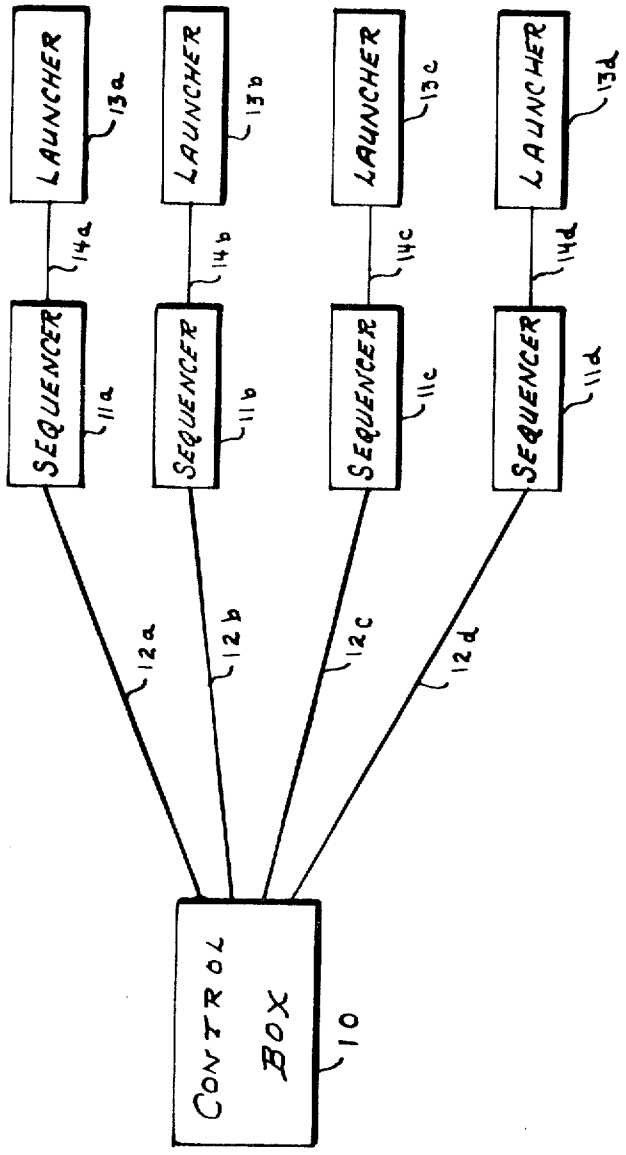

LAUNCHER
13a
LAUNCHER
13b
LAUNCHER
13c
LAUNCHER
13d
14a
14b
14c
14d
SEQUENCER
11a
SEQUENCER
11b
SEQUENCER
11c
SEQUENCER
11d
12a
12b
12c
12d
CONTROL BOX
10

FIG. 1

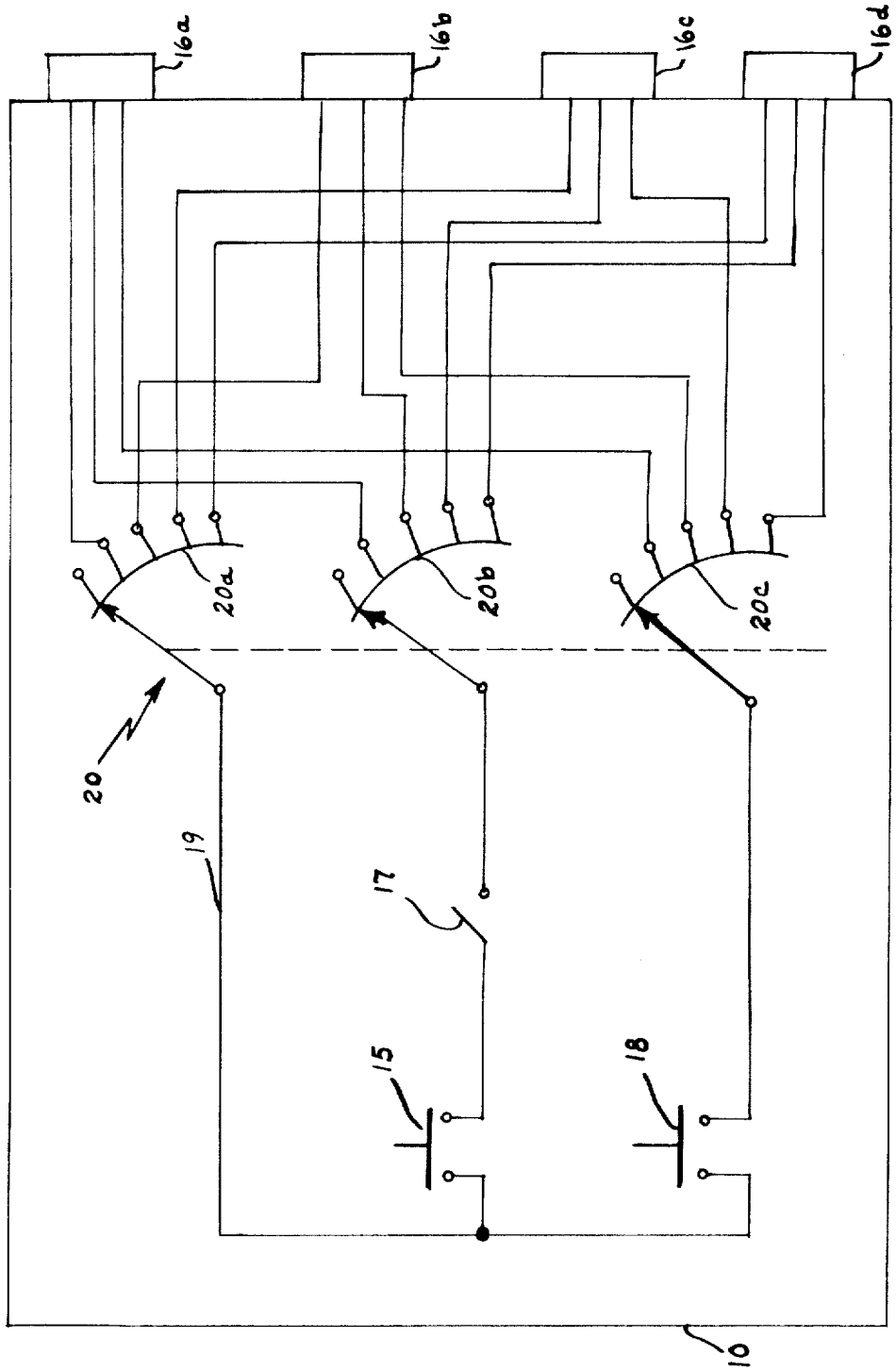
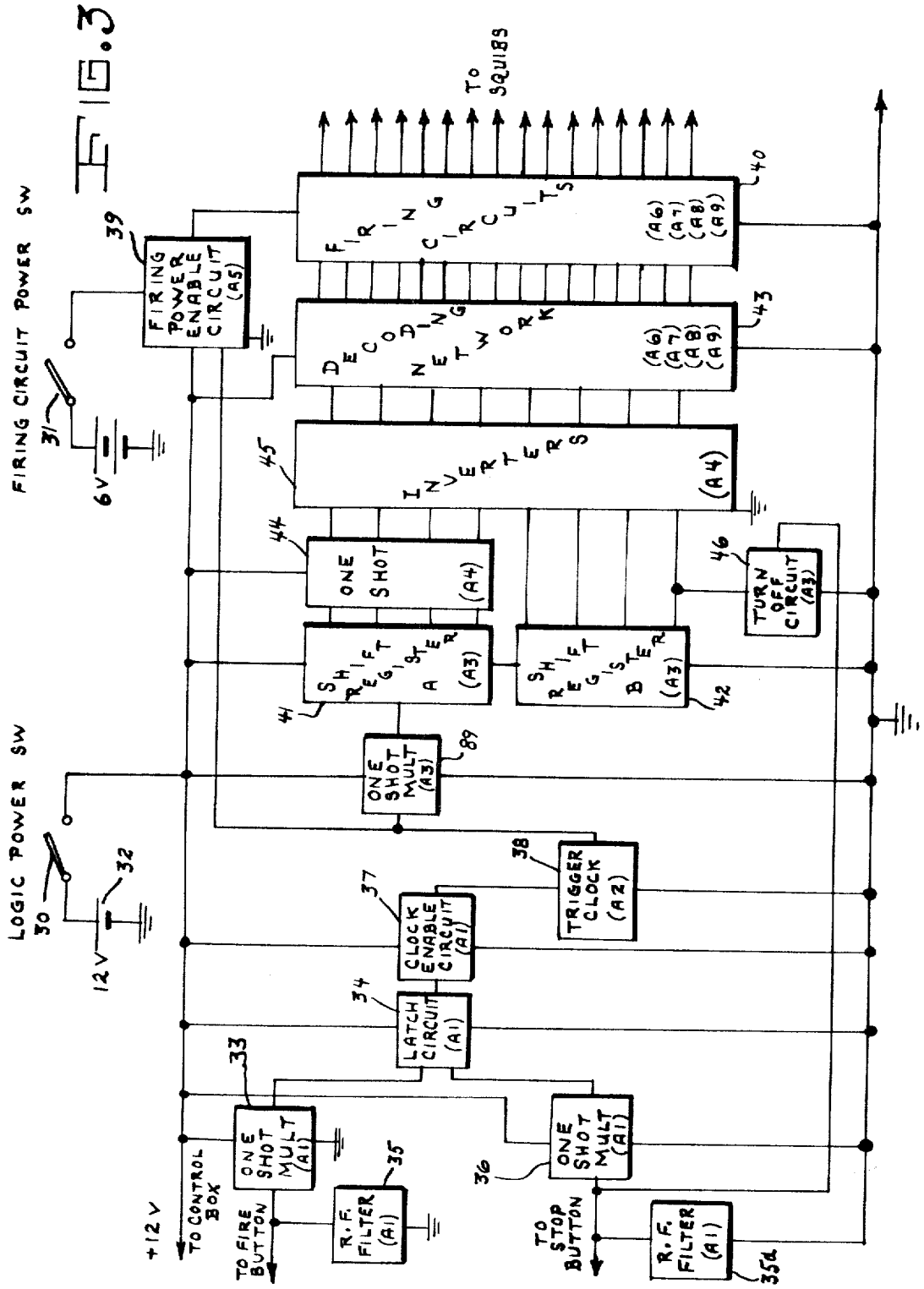


FIG. 2

FIG. 3


TO SQUIBS
FIRING CIRCUITS
(A6) (A7) (A8) (A9)
40
DECODING NETWORK
43
INVERTERS
(A4)
45
ONE SHOT
(A4)
44
SHIFT REGISTER A
(A3)
41
SHIFT REGISTER B
(A3)
42
TURN OFF CIRCUIT
(A3)
46
ONE SHOT MULT
(A3)
89
FIRING POWER ENABLE CIRCUIT
(A5)
39
FIRING CIRCUIT POWER SW
31
6V
LOGIC POWER SW
30
32
12V
TRIGGER CLOCK
(A2)
38
CLOCK ENABLE CIRCUIT
(A1)
37
LATCH CIRCUIT
(A1)
34
ONE SHOT MULT
(A1)
33
ONE SHOT MULT
(A1)
36
+12V
TO CONTROL BOX
TO FIRE BUTTON
R.F. FILTER
(A1)
35
TO STOP BUTTON
R.F. FILTER
(A1)
35A

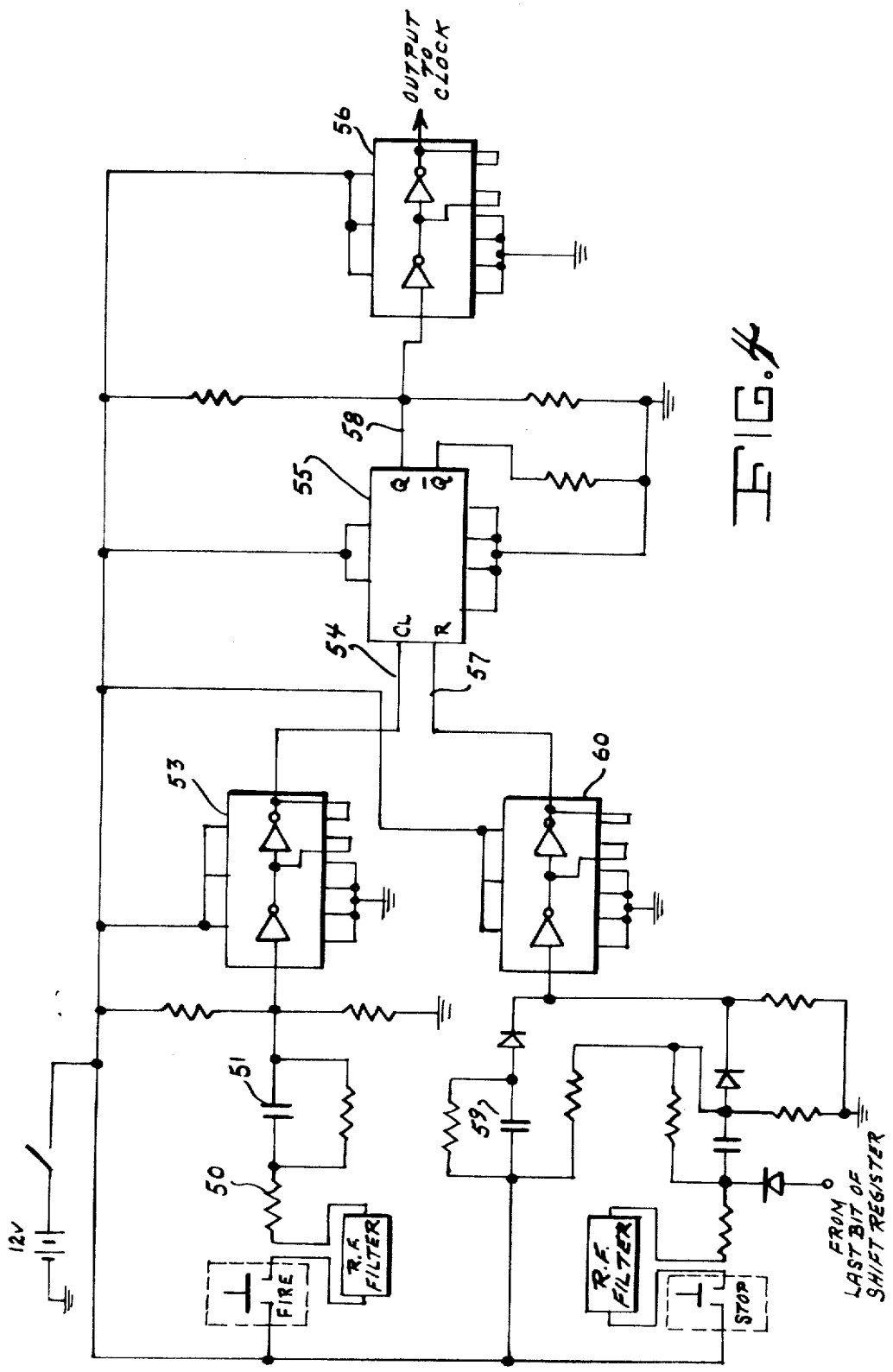

OUTPUT TO CLOCK
56
58
55
Q
Q
CL
R
54
57
53
60
51
50
59
12V
FIRE
R.A. FILTER
R.F. FILTER
STOP
FROM LAST BIT OF SHIFT REGISTER

FIG. 4

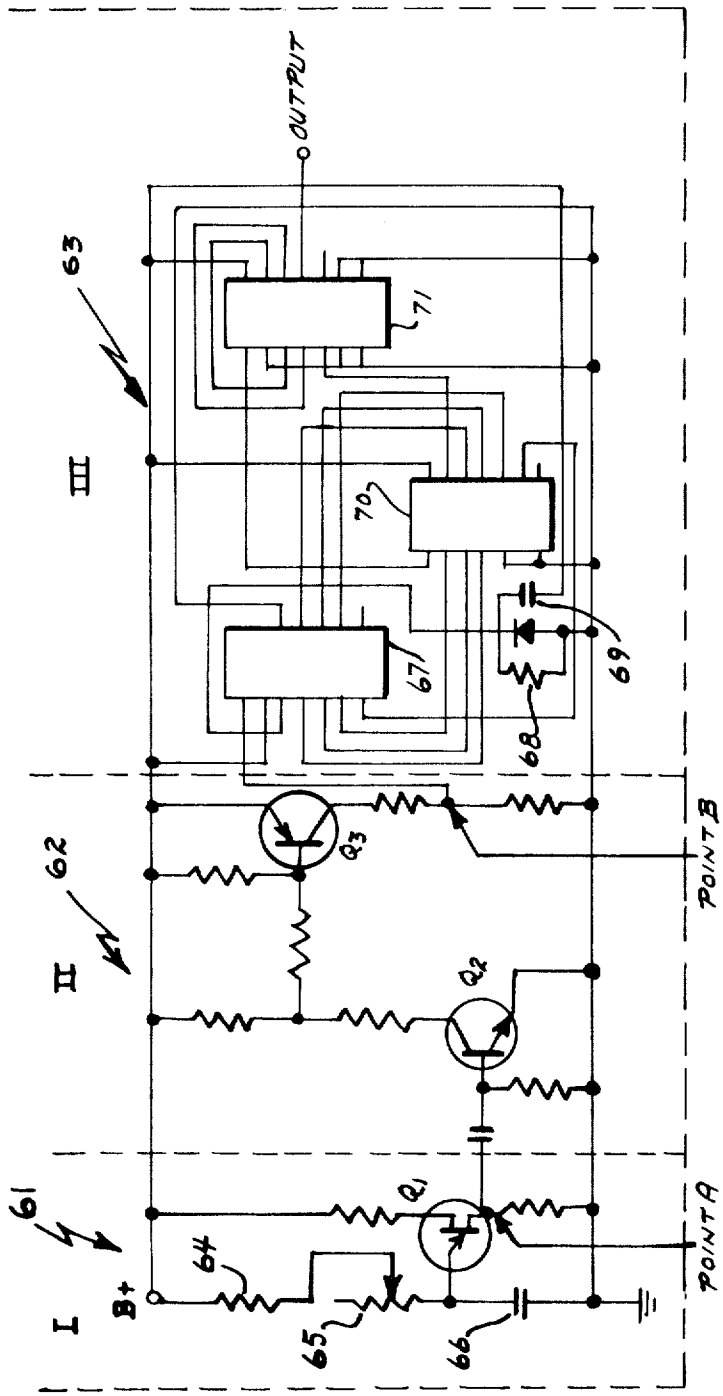

OUTPUT
63
III
71
70
67
69
68
62
II
Q3
Q2
POINT B
Q1
61
I
B+
64
65
66
POINT A

FIG. 5

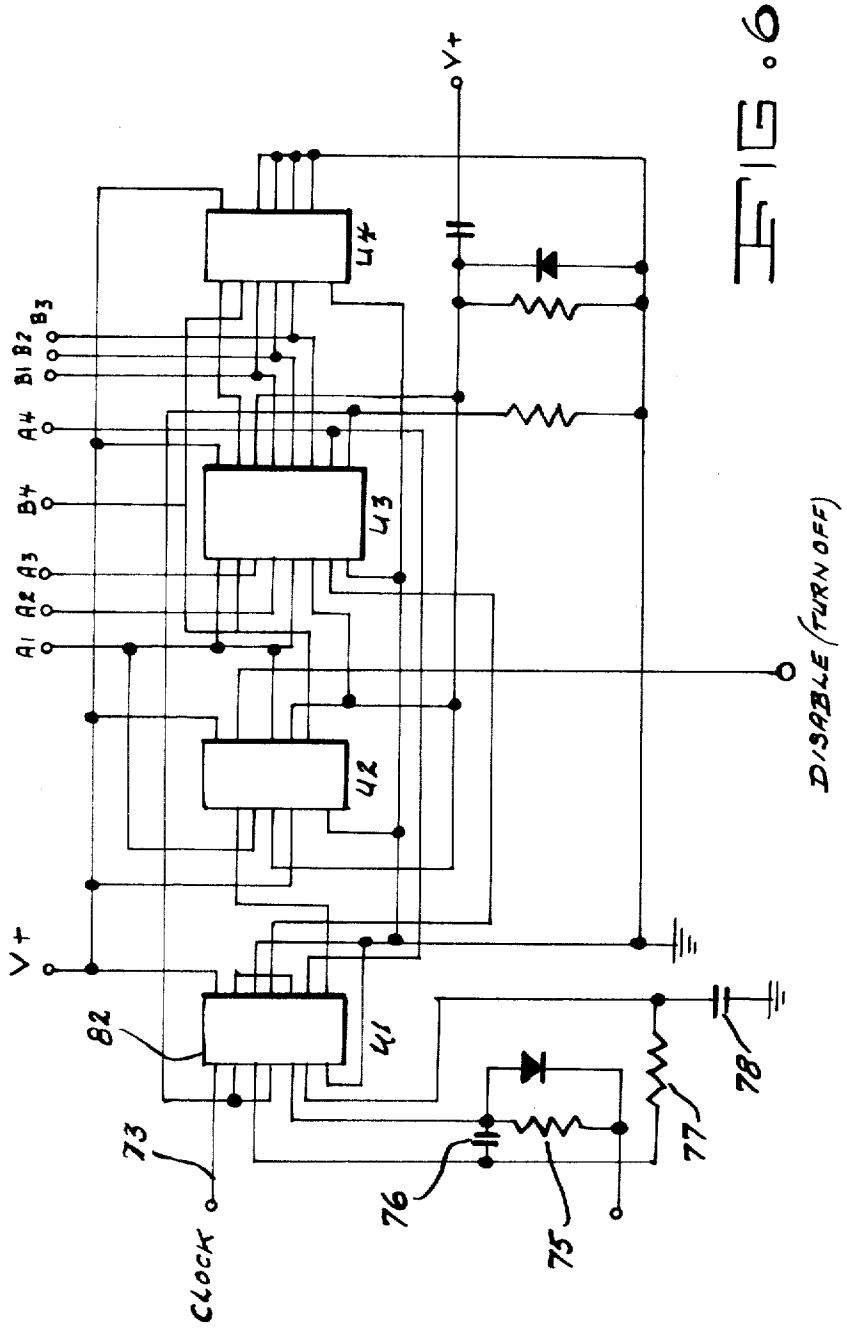

V+
44
43
42
41
B3
B2
B1
A4
B4
A3
A2
A1
V+
B2
73
CLOCK
76
75
77
78
DISABLE (TURN OFF)

FIG. 6

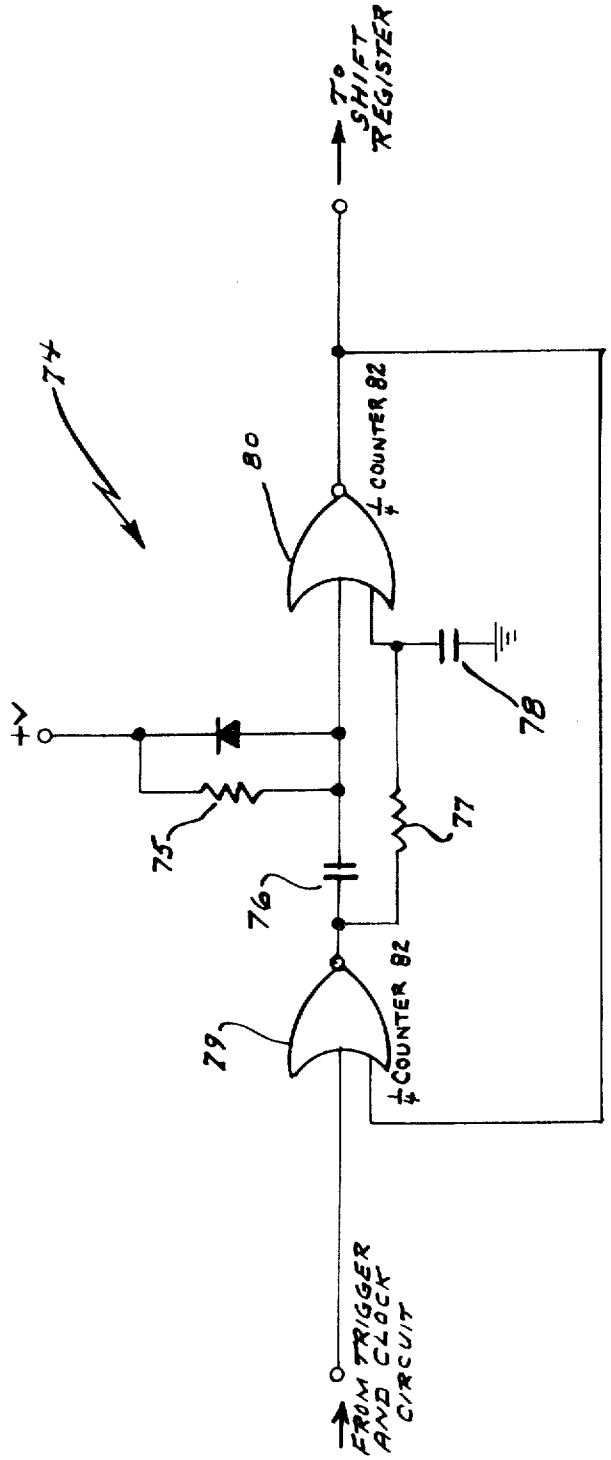

TO SHIFT REGISTER
74
80
÷ COUNTER 82
+V
78
75
77
76
÷ COUNTER 82
79
FROM TRIGGER AND CLOCK CIRCUIT

FIG. 7

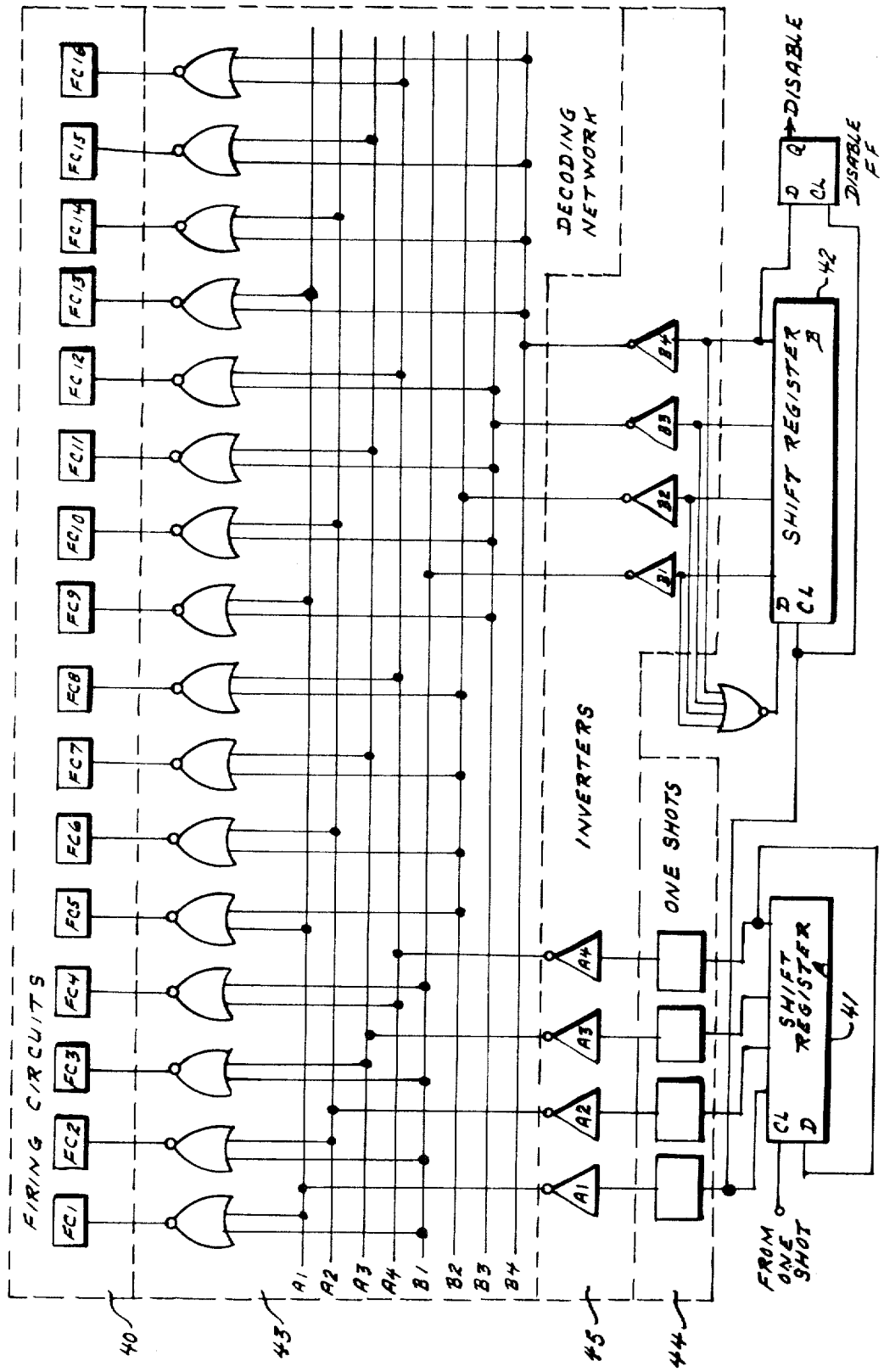

FIRING CIRCUITS
FC1
FC2
FC3
FC4
FC5
FC6
FC7
FC8
FC9
FC10
FC11
FC12
FC13
FC14
FC15
FC16
DECODING NETWORK
A1
A2
A3
A4
B1
B2
B3
B4
INVERTERS
ONE SHOTS
SHIFT REGISTER A
SHIFT REGISTER B
D
CL
Q
DISABLE
DISABLE FF
FROM ONE SHOT
40
41
42
43
44
45

FIG. 8

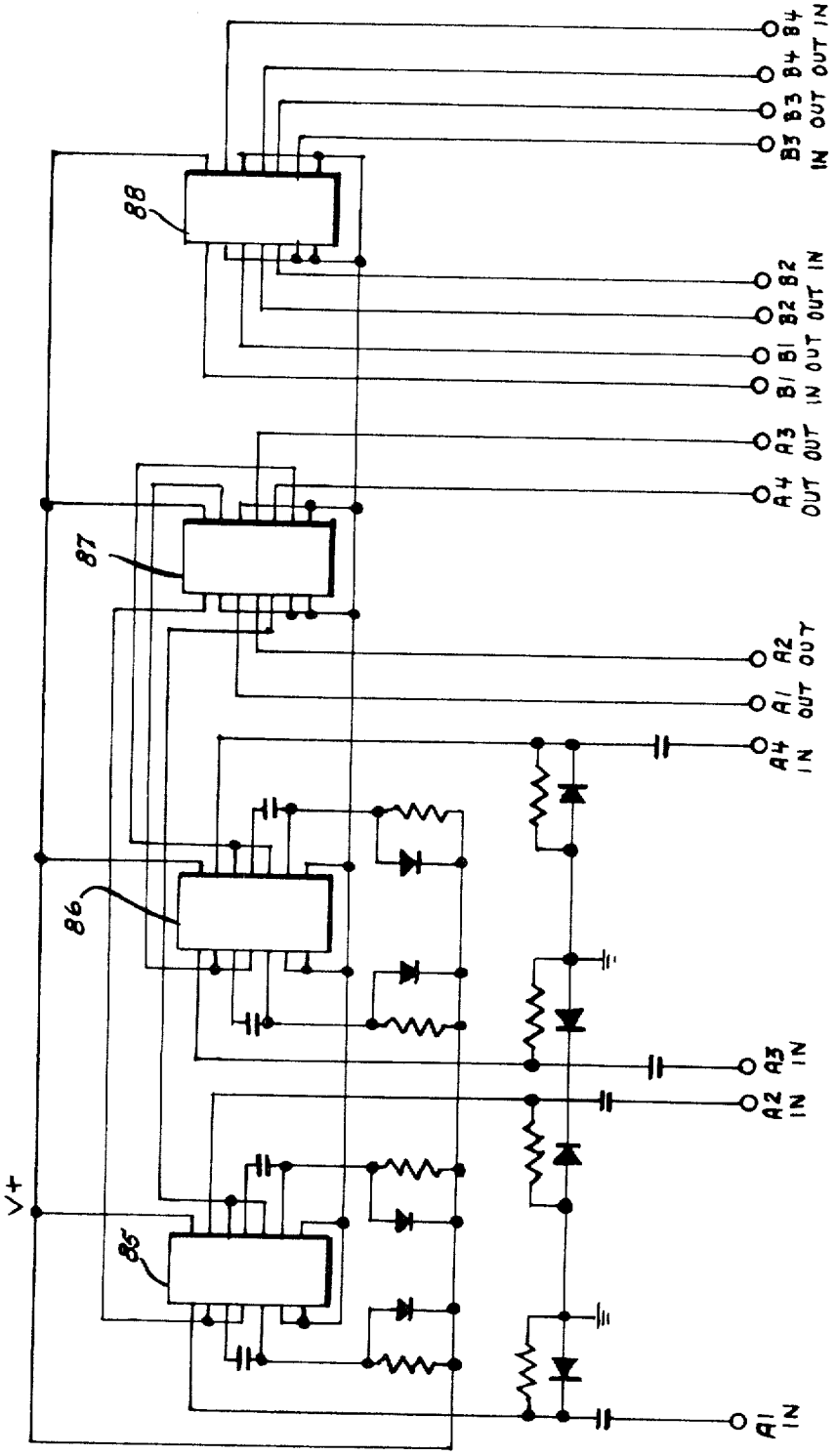

B3 B4 B4
IN OUT OUT IN
B2 B2
B1 B1 B2
IN OUT OUT IN
A3
A4 A3
OUT OUT
A2
A1 A2
OUT OUT
A4
IN
A3
IN
A2
IN
A1
IN
V+
88
87
86
85

FIG. 9

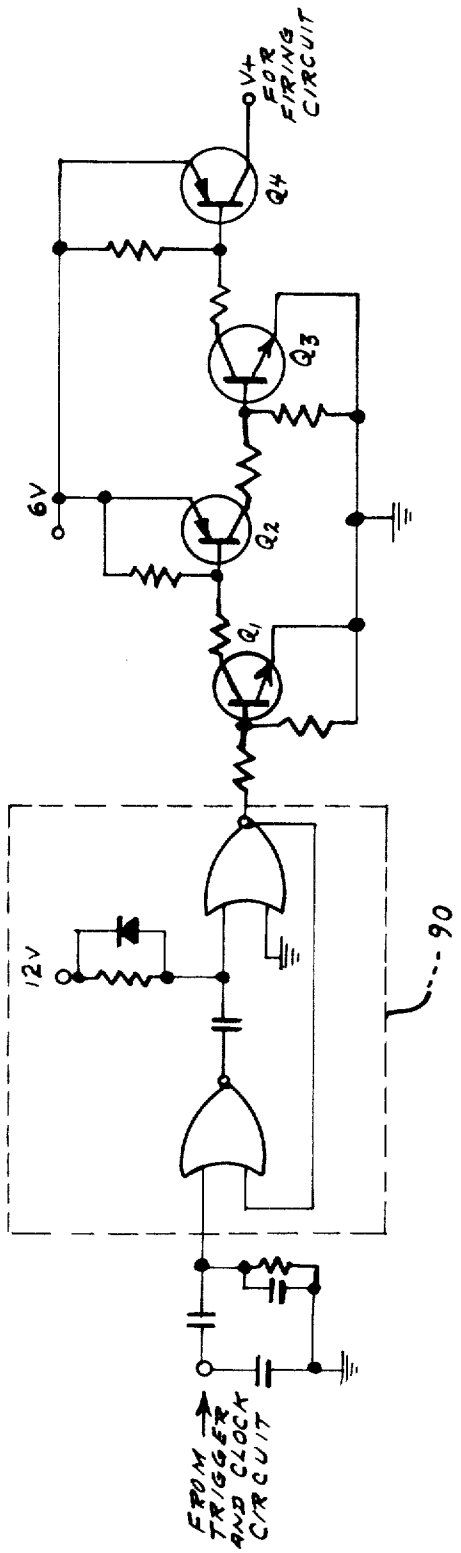

V+ FOR FIRING CIRCUIT
Q4
Q3
Q2
Q1
6V
12V
90
FROM TRIGGER AND CLOCK C/R CUIT

FIG. 10

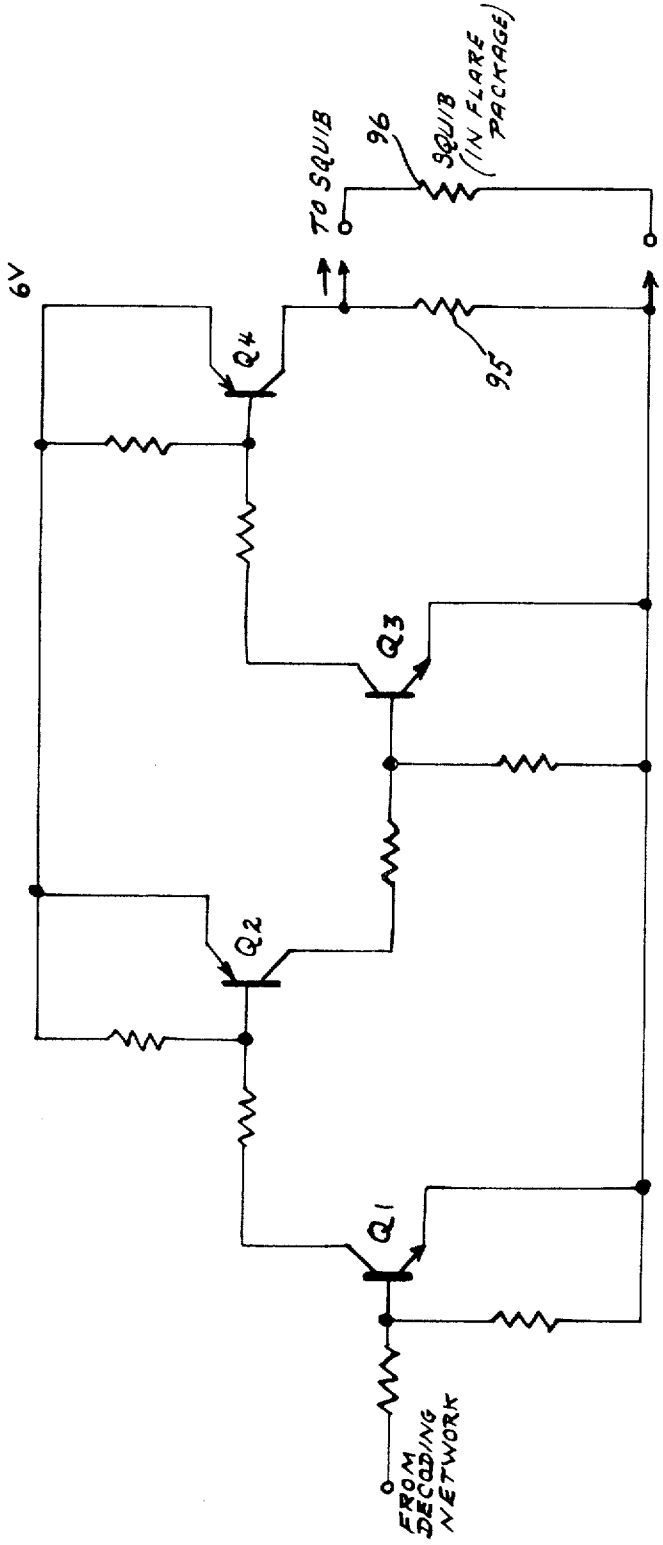

6V
Q4
Q3
Q2
Q1
95
96
TO SQUIB
SQUIB (IN FLARE PACKAGE)
FROM DECODING NETWORK

FIG. 11

INTERVALOMETER FOR PARACHUTE FLARE LAUNCHER

BACKGROUND OF THE INVENTION

The present invention relates broadly to a remote-control launching system and in particular to an intervalometer for a parachute flare launching apparatus.

In the defense of military installation, such as an air force base, the problem of an adequate base perimeter defense arises. In order to defend an air force base from enemy attack by infiltration, there is a requirement for immediate illumination of the perimeter area. This immediate light may be provided through the use of parachute flares which are fired from flare launchers. However, this technique has some inherent problems even though the requirement of immediate light is satisfied. The flare launchers which will be located in various positions around the base perimeter require an operator at each location. The position must be constantly manned to prevent any unneccesary delay in providing the immediate light. Once the flare launchers begin operation, their positions may be readily detected by hostile forces by the sound or sparks from the rockets which launch the flares. Thus, there is danger to the operator of the launch system from hostile fire. Further, in the case of an explosion of the pyrotechnics or rocket motors either by a direct hit or other reason, the operator is endangered. The present invention provides a system whereby the immediate light requirements will be satisfied without the inherent dangers to the operator. The system may be deployed around the base perimeter and controlled by a single operator in a position which is remote to launcher positions. In addition, the system could be used with other types of ordnance such as, smoke rockets or high explosive warheads.

SUMMARY

The present invention utilizes an intervalometer which is a self-contained, battery operated unit for firing ground based parachute flares from four 16 round flare launchers. One complete intervalometer system consists of a control unit and four sequencer units. Each sequencer unit is connected to the control unit by a 1,000 foot cable, and the sequencer unit is connected to a flare launcher by an eight foot cable. The control unit provides a package selector switch, a safe-arm switch, a firing switch and a stop switch. The sequencer unit contains batteries, firing circuitry, low power logic, initiation and timing circuitry, and two safety switches. One safety switch controls logic power and the other controls firing power. During operation, the sequencer unit provides the electrical pulse to ignite the rocket motor which launches the flare. The sequencer unit also controls the time interval between subsequent flare launchings. The intervalometer is designed for use with base perimeter defense systems. The flare firing sequence can be interrupted and restarted at any time without loss of memory, and the sequence may be started in all four sequencer units. The intervalometer may be modified to operate with intrusion detection systems.

It is one object of the invention, therefore, to provide an intervalometer apparatus having a central control unit to fire flares from four different 16 round flare launchers which are each located 1,000 feet from the control unit.

It is another object of the invention to provide an intervalometer apparatus utilizing a completely solid state device for the initiation and sequencing for a ground based ordnance dispenser.

It is still another object of the invention to provide an intervalometer apparatus utilizing medium scale integration and complementary-symmetry MOS devices for control and gating circuitry.

It is yet another object of the invention to provide an intervalometer apparatus having the capability of firing flares by igniting 1 amp, 1 watt squibs which require 5 amps for at least 20 milliseconds.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram of the parachute flare launcher system,

FIG. 2 is a schematic diagram of the control box,

FIG. 3 is a block diagram of the sequencer box,

FIG. 4 is a schematic diagram of the circuitry on printed circuit board A1,

FIG. 5 is a schematic diagram of the trigger and clock circuit,

FIG. 6 is a schematic diagram of the shift register circuits,

FIG. 7 is a logic diagram of the one-shot multivibrator,

FIG. 8 is a logic diagram of the circuitry associated with the shift registers through firing circuits of FIG. 3,

FIG. 9 is a schematic diagram of the one-shots and inverters circuits of FIG. 3,

FIG. 10 is a schematic diagram of the firing power enable circuit of FIG. 3; and,

FIG. 11 is a schematic diagram of one of the firing circuits contained in the firing circuits of FIG. 3.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. 1, there is shown a block diagram of an intervalometer apparatus deployed in a parachute flare launcher system. A control box **10** is connected to four individual sequencer units **11***a*–**11***d* by four one thousand foot cables **12***a*–**12***d*. The sequencer units **11***a*–**11***d* are each connected to parachute flare launcher units **13***a*–**13***d* by 8 foot cables **14***a*–**14***d*. The control box **10** provides the capability of selecting any one of the four sequencer-launcher units for firing. The control box **10** provides a further control feature in that the firing sequence in a given launcher may be stopped or interrupted and an other launcher is selected for firing. Thus, the control box **10** has complete selection control over which launcher unit is to be operated, control to initiate the firing of another selected launcher unit.

FIG. 2 is schematic diagram of the control box **10** illustrating the control features described above. The control box **10** has four connectors **16***a*–**16***d* to which are connected the 1,000 foot cables from the sequencer units **11***a*–**11***d* of FIG. 1. A rotary switch **20**, such as a type V-71053 manufactured by J.B.T Instruments Inc. having three wafers **20***a*–*c* with five positions, receives the input lines from the sequencer units.

The ganged wiper arms of the rotary switch **20** are shown in the first switch position which is the off position. When the switch is rotated to the second switch position, the first sequencer unit may be operated. The switch positions continue in order until the last position is reached. The last switch position represents the

fourth sequencer unit. When a sequencer unit is selected, the logic power output is connected to the line **19** through the wiper arm of wafer **20***a*. If the logic power switch of the selected sequencer unit is in the on position, + 12 volts logic power will appear on line **19**. The logic power will be applied to both the fire push button switch **15** and the stop push button switch **18**. The fire button **15** and the stop botton **18** are shown in the normally open position. The safe-arm switch which is shown in the normally open position (safe position) must be closed (arm position) before the fire button **15** can activate the selected sequencer unit. Once the safe-arm switch **17** is closed, the firing sequence may be initiated by depressing the fire button **15**. If it is desired to interrupt or halt the firing sequence in the selected sequencer unit, the stop button **18** must be depressed. Thus, it may be seen that the control box **10** provides the capability of selecting and controlling a particular sequencer unit.

Turning now to FIG. **3**, there is shown a block diagram of the circuitry in the sequencer box. The sequencer box contains printed circuit boards which are numbered A1 through A9. The printed circuit boards numbers are shown in parenthesis in the appropriate block. The operation of the sequencer box is as follows, the logic power switch **30** should be closed first, and then the firing circuit power switch **31** should be closed. When switches **30, 31** are closed, the circuitry of the sequencer box receives power and is in a standby mode. During this time, the current drain from the logic power battery **32** is approximately 0.02 milliamps. In order to initiate the firing sequence, the switches in the control box must be in the proper positions. The package selector switch **20** must be pointed to the appropriate package number, the "Safe-Arm" switch **17** must be in the "Arm" position, and the "Fire" button **15** must be pressed. When the "Fire" button **15** is pressed, one shot multi **33** on the fire line is triggered, and a short pulse is transmitted to the latch circuit **34**. The purpose of the RF filters **35, 35***a* is to filter out radio or radar frequencies which may be picked up by the 1,000 ft. unshielded wire.

The output of the latch circuit **34** goes high when it is triggered by the fire one shot multi **33**, and will remain high until toggled by the stop button one shot multi **36**. The high output of the latch circuit **34** energizes the clock enable circuit **37** which transmits operating power to the trigger and clock circuit **38**.

The trigger and clock circuit **38** provides a pulse at its output immediately and also starts the 60 second clock. The pulse at the output of the trigger and clock **38** does two things:

1. It triggers the firing power enable circuit **39** which provides firing power to the firing circuits **40**; and,

2. It triggers the first shift register, Shift Register A, **41**. Shift registers A and B, (**41, 42**) are 4 bit shift registers.

The two shift registers are set up so that the first output of shift register A, **41** and shift register B, **42** will go high on the first clock pulse. Thereafter, shift register A, **41** will shift one bit for each clock pulse, and shift register B, **42** will shift each time shift register A, **41** completes it fourth cycle. The outputs of the two shift registers form a counter that uses the base four. Shift register A, **41** acts as the unit column, and shift register B,**42** acts as the base column. The eight outputs of the shift registers **41, 42** are converted to **16** outputs by the decoding network **43**, which consists of **16** two-input NOR gates. As the sequence steps through, the decoding network **43** allows only one firing circuit to be triggered for each clock pulse. The one-shots **44** at the outputs of shift register A, **41** limit the time that the firing circuits **40** will be energized to save battery current. The inverters **45** are necessary to allow the NOR gates in the decoding network **43** to be used as two-input AND gates. The purpose of the firing power enable circuit **39** is to ensure that the firing circuits **40** receive power only when a pulse is generated by the trigger and clock circuit **38**.

When the operator wants the sequence to stop, the "Stop" button **18** is pressed. The one shot multi **36** on the stop button line is triggered and provides a pulse to the latch circuit **34**. The output of the latch circuit **34** goes low. The low output of the latch circuit **34** turns off the clock enable circuit **37** which interrupts operating power to the trigger and clock circuit **38**. After the trigger and clock circuit **38** has been stopped, the shift registers **41, 42** will remain at the same position until the "Fire" button **15** is pressed again. The shift registers **41, 42** will then advance to the next position. The only other way that the shift registers **41, 42** will move from their last position is, if the logic power switch **30** is opened. Then the shift registers **41, 42** will reset to zero. The turn off circuit **46** will stop the sequence approximately 60 seconds after the 16th firing circuit is triggered.

FIG. **4** is a schematic of the circuitry contained on the printed circuit board A1. The fire and stop switches are not actually contained on A1, but are shown in FIG. **4** for convenience.

When the "Fire" button is pushed, voltage passes through the 1,000 ft. wire and appears at resistor **50** in FIG. **4**. A pulse is formed by resistor **50** and capacitor **51** which is amplified and shaped by amplifier **53**. This pulse enters the clock input **54** of the flip-flop **55**. The output of flip-flop **55** goes high and triggers unit **56** which energizes the clock and trigger circuit **38**.

The stop circuit works the same way, and the pulse into the reset line **57** of the flip-flop, **55**, causes the Q output **58** to go to ground. This lowers the output of unit **56** thereby removing power from the trigger and clock **38**.

During voltage turn on, the capacitor **59** causes unit **60** to give a pulse into the reset line **57** which holds the Q output **58** of the flip-flop **55** low. This is a safety feature, in case the fire circuit gives an output pulse during voltage turn on, the capacitor **59** will provide a pulse five times as long and prevent the flip-flop **55** from setting and firing a flare.

The trigger and clock circuit which is shown in FIG. **5** consists of a unijunction oscillator **61**, a pulse shaper **62**, and a frequency divider circuit **63**. The circuit shown in FIG. **5** is shown divided in three sections wherein Section I is the oscillator, Section II is the pulse shaper, and Section III is the frequency divider. The operating power for the entire board is provided by the clock enable circuit **37** on printed circuit board A1 (FIG. **4**). This circuit operates only after the Fire button **15** (FIG. **2**) is pressed. Before the Fire button **15** is pressed and also after the Stop button **18** has been pressed, the circuit on printed circuit board A2 in FIG. **5** is inoperative.

When the clock enable circuit **37** provides power to board A2, a pulse is provided to the reset line of the

seven stage binary counter **67**. This pulse which is provided by the network, resistor **68** and capacitor **69**, sets all inputs of the binary counter **67** low, and this low output is gated by NOR gates **70, 71** as a positive pulse at the output of NOR gate **71**. This pulse triggers the shift register **41** (FIG. 3) and turns on the firing circuit power **39** (FIG. 3), causing a flare to be fired immediately when the fire button is pressed for the first time.

When the clock enable circuit **37** (FIG. 3) provides power to trigger and clock circuit **38** (FIG. 3) 3) on board A2, the oscillator **61** in Section I begins to operate. A sawtooth wave is provided by resistors **64, 65** and capacitor **66** with the period adjustable by resistor **65**. In order to obtain a **60** second period at the output of NOR gate **71**, a period of 468 milliseconds is needed at the output of transistor Q1, point A.

Section II is the pulse shaping network **62** which transforms the sawtooth wave into a pulse of sufficient voltage and adequate rise, fall and duration times. The pulse at point B has a voltage of 8 volts, and a pulse duration of 12 microseconds. The rise and fall times are no greater than 15 microseconds which is the required maximum for the 7 bit counter **67**.

FIG. **6** is a schematic of the circuitry of printed circuit board A3. The logic diagram of the one shot in FIG. **6** is shown in FIG. **7** is a logic diagram of the block diagram circuits of FIG. **3** illustrating the logic flow from shift registers **41,42** through to the firing circuits **40**. The shift register clock input requires a pulse that is no greater than 400 milliseconds with rise and fall times no greater than 15 microseconds. Trigger and clock circuit **38** (FIG. 3) provides a pulse that is 468 milliseconds wide, so that the one shot circuit **74** which is shown in FIG. 7 is needed. The RC time constant which is provided by resistor **75** and capacitor **76** determines the pulse width of the output and resistor **77** and capacitor **78** provide a lag network to prevent the gates **79** and **80** from oscillating.

The two-shift registers **41, 42** (FIG. 3) are both contained in one package, U3 in FIG. **6**. Each shift register is connected to form a ring counter. The first clock pulse will set the firsdt output of both registers high. Subsequent clock pulses will shift the output one bit for each clock pulse for shift register **41** and one bit for each four clock pulses for shift register **42**. The decoding network **43** allows only one firing circuit to be triggered at a time. The outputs of the shift register **41** feeds into one-shot circuit **44** which are set for 1 ½ seconds. This limits the time that the firing circuits **40** will be turned on. When the fourth output of shift register **42** goes high, the data input of the disable flip-flop will be high. The flip-flop will be triggered when the first output of Shift Register A **41** goes high the next time, and this will cause the sequencer to be turned off after the 16th firing circuit has been triggered.

FIG. **9** is a schematic of the circuitry which is contained on printed circuit board A4. The printed circuit board A4 contains four one-shot circuits and **8** inverters. The two input gates in NOR gates **85, 86** are used with resistors, capacitors and diodes to form one-shots which are similar to the one-shot circuit shown in FIG. **7**. The pulsed output of the one-shots are then passed through the inverters which are made from two input gates in NOR gate **87**.

The four outputs from shift register **42** are inverted by the Quad **2** inputs gates of NOR gate **88**. The inverters are necessary to allow the two input NOR gates in the decoding network **43** to act as 2-input AND gates.

The FIG. **10** is a schematic of the printed circuit board A5, the firing power enable circuit **39** (FIG. 3). The pulse from the trigger and clock circuit **38** while triggering the shift register **41** also triggers the firing power enable circuit **39**. The pulse triggers the one-shot multi **89** (FIG. 3), which consists of two gates in NOR gate **85** (FIG. **9**), and the resistors capacitors and diodes (shown in FIG. **10** by the reference numeral **90**). The output of the one-shot circuit **90** triggers transistor Q1 on. Transistors Q2 and Q3 are gain stages which are required to turn on transistor Q4. Transistor Q4 is the large power transister which will conduct the current from the **6** volt batteries to the firing circuits **40** (FIG. 3).

FIG. **11** is a schematic diagram of one of the firing circuits which is contained in firing circuit **40** of FIG. **3**. There are **16** paralleled firing circuits. These firing circuits are contained on four printed circuit boards having four firing circuits on each printed circuit board. The decoding network **43** (FIG. 3) will turn on each firing circuit in its proper sequence. The transistor Q4 of FIG. **10** is turned on by the gain stages Q2, Q3 and conducts **6** amps for 1 1/2 seconds. The 6 amps will be drawn only during the first 20 milliseconds, after which the squib will be open and the collector current of transistor Q4 will be reduced by the resistor **95**. The squib is shown as a resistor **96**. The 1 1/2 seconds that the firing circuit turns on, is controlled by the one-shot circuits **44** at the output of shift register **41**. This time is also controlled by the one-shot circuit **44** which is in the firing power enable circuit **39**.

Although the invention has been described with reference to a particular embodiment, it will be understood to those skilled in the art that the invention is capable of a variety of alternative embodiments within the spirit and scope of the appended claims.

We claim:

1. An intervalometer apparatus for a parachute flare launcher system comprising in combination:

a control box providing output control signals, said control box having a logic power voltage, said logic power voltage being applied to a fire switch and a stop switch, said fire switch being connected to a safe-arm switch, said fire switch providing a fire output signal, said stop switch providing a stop output signal, said output control signal being said fire and stop output signals,

a plurality of sequencer units, each of said plurality of sequencer units respectively connected to said control box by individual 1000 foot cables, each of said plurality of sequencer units receiving said output control signals, said sequencer units providing a firing power output signal, said firing power output signal occurring in a predetermined time interval, said firing power output signal having a predetermined output level, and,

a plurality of parachute flare launcher units having a predetermined number of parachute flares, said plurality of parachute flare launcher units being respectively connected to said plurality of sequencer units by an 8 foot cable.

2. An intervalometer apparatus as described in claim **1** wherein said control box further includes a rotary switch to provide said output control signal to said plurality of sequencer units individually.

3. An intervalometer apparatus as described in claim **1** where said predetermined time interval is 1.5 seconds.

4. An intervalometer apparatus as described in claim **1** wherein said plurality of sequencer units comprises four sequencer units.

* * * * *