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(54) **OPTICAL PROCESS VARIABLE TRANSMITTER**
OPTISCHER SENDER FÜR PROZESSVARIABLEN
EMETTEUR OPTIQUE A VARIABLE DE PROCESSUS

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- **AL.: 'OPTICALLY INTERFACED SENSOR SYSTEM FOR AEROSPACE APPLICATIONS ' see the whole document**

EP 0 571 382 B1

Description

This invention relates to process variable transmitters which are optically energized and provide optical outputs representing the process variable.

The terms light, optic, and radiation as used herein refer to visible and invisible electromagnetic radiation with wavelengths shorter than about 100 microns (100,000 nanometers); the terms electric, electrical used herein refer to lower frequency phenomenon such as commonly occur in electronic circuits operating at frequencies below 100 MHz. The term "process variable" used herein refers to a variable such as pressure, temperature, flow, velocity, specific gravity, etc. sensed by a transmitter such as a process control or aerospace instrument.

US-A-4346478 discloses a fibre optical sensor system for measuring physical parameters. Measuring elements are provided for measuring physical parameters which may be, for example, pressure, temperature, gas flow and speed in an automobile. The measuring elements are energized by energy received from a light beam. The measuring element further comprises a transducer unit for transforming the physical parameter to be measured into a corresponding electrical quantity and subsequently into an optical signal.

EP-A-0149286 discloses a system for communicating information between remote locations in which the communication function and the function of providing energy for powering the devices at the remote locations is effected by a radiant energy beam generating means such as a laser.

EP-A-0180423 discloses a system for remotely adjusting parameters of sensors. The sensor is connected to a digital highway that provides representative digital signals of the sensed variable to a central unit. A remote control hand-held unit is used to modify parameters such as span, zero and linearity using light in the infrared spectrum. The digital highway could be optical fibres.

I.S.A. Transactions, Volume 26, No. 1 (1987), "Optically Interfaced Sensor System for Aerospace Applications" (Patriquin et al) discloses a technique for fibre optic interconnection of interfaces to conventional sensors. The method eliminates wired interconnections while maintaining use of proven sensor technology.

SUMMARY OF THE INVENTION

In the present invention as set forth in claim 1, light coupled into a light input of a transmitter energizes electrical circuitry in the transmitter. The light coupled into the light input is modulated with commands which control operation of the transmitter including commands which program one or more reprogrammable transmitter output parameters. The transmitter comprises sensor means which sense a process variable, and the transmitter transmits a programmed optical output indicating the process variable to a medium or waveguide which carries the optical output. The sensor means generate an electrical sensor output representative of the process variable. The electrical sensor output is coupled to circuit means in the transmitter which generate an electrical transmitter output indicating the process variable adjusted or programmed by a changeable or programmable parameter stored in the circuit means. The circuit means comprise an energization input for energizing the circuit means. The transmitter further comprises conversion means for converting the programmed electrical transmitter output to the programmed optical output. The conversion means further includes receiver means for receiving light to convert a first portion of the received light into electrical energy provided to the energization input and for converting a second portion of the received light into an electrical output controlling stored changeable parameters in the circuit means, thus providing programming of the transmitter output.

The transmitter is coupled via a medium or waveguide means to an interface coupled to an electrical data bus. The interface as set forth in claim 14 comprises light generating means coupled to the waveguide means and including first means for generating a programming light component modulated to program the transmitter's generation of an optical output by adjusting the stored changeable parameter. The light generating means further comprise second means for generating an energizing light component to energize the transmitter. The interface further comprises control means coupled to the light generating means for electrically controlling the modulation as a function of a first reference receive from the bus and for electrically controlling amplitude of the energizing light component as a function of a second reference in the control means. The interface further comprises receiver means for providing an electrical output to the bus representative of a programmed optical output received from the transmitter.

In a preferred multidrop arrangement, the waveguide couples to a plurality of optical process variable transmitters and the light generating means further comprise means for generating a programming light component modulated to program generation of optical outputs by the plurality of addressable transmitters. The programming light component is preferably modulated according to a serial data protocol.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows an embodiment of an optical transmitter coupled via waveguides to an interface.

FIG. 2 shows a second embodiment of an optical transmitter coupled via a waveguide to an interface.

FIG. 3 shows an embodiment of a DC to DC converter circuit used in an optical transmitter.

FIG. 4 shows an embodiment of an optical transceiver coupled to a waveguide.

FIG. 5 shows a second embodiment of a optical transceiver coupled to a waveguide.

FIGS. 6, 7 and 8 show three embodiments of multi-drop optical transmitters coupled to a waveguide.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In FIG. 1, optical pressure transmitter 10 senses process variable 12 and communicates via waveguides 14, 16 with interface 18. Interface 18 interfaces the optical signals on waveguides 14,16 to electrical bus 22 connecting to control system 24 so that two-way communication is established between transmitter 10 and control system 24, with electrically insulating waveguides providing galvanic isolation between the transmitter 10 and bus 22.

Sensed process variable 12 can be pressure, temperature, flow, pH, or the like. Waveguides 14, 16 can be single or multiple strand fiber optic cable and can extend from a short distance up to thousands of meters in length as desired for a particular installation. Transmitter 10 is electrically isolated from control system 24 by waveguides 11, 16 which conduct light but not electric current, thus preventing undesired coupling of electrical energy between control system 24 and transmitter 10.

Light generator 26, which can be a laser, couples light to transmitter 10 via waveguide 14. Light generator 26 generates a first light component which is modulated to program transmitter 10 so that the transmitter's output on waveguide 16 is a programmed output. The modulation of the first light component will normally be a serial data string in a standard serial communication protocol using FSK techniques such as the HART Brand Communication Protocol of Rosemount Inc. or other standard protocol. Programming can comprise storing the settings for span, zero, range, or the like in memory in the transmitter 10 for scaling the transmitter's output. The first light component can also be modulated to interrogate the transmitter. The transmitter responds to the interrogation with previously stored data such as transmitter location, the transmitter's materials of construction, diagnostic data, compensation and linearization data, and the like.

Light generator 26 generates a second light component which energizes transmitter 10, and this component is normally not modulated. Controller 28 controls the operation of light generator 26. A first reference applied to analog buffer 30 controls modulation of the first light component. A second reference in controller 28 controls amplitude or magnitude of the second light component so that a controlled amount of optical power is provided to waveguide 14. Controller 28 generates a modulated electrical output which is applied to a laser diode in light generator 26 to modulate the light output. Bus 22 provides the first reference to buffer 30, typically comprising serial digital words indicating changes to the programming of transmitter 10, and indicating interrogation commands to be sent to transmitter 10, as well.

Interface 18 receives transmitter 10's light output from waveguide 16 at receiver 32, which can comprise a photodiode detector. Receiver 32 converts the received light output to an electrical signal for transmission to bus 22.

Control system 24 comprises a control 34 which can comprise a computer coupled to bus 22 via modem 36. Control computer 34 provides the reference to the bus which is amplified by analog buffer 30. Control computer 34 receives information contained in the transmitter's light output about the process variable from bus 22 and uses the information to control a process (not shown) or parameter of the process generating the process variable 12.

In transmitter 10, coupler 38 splits light from light generator 26, coupling, in one preferred embodiment, approximately 1% to convertor 42 and coupling the remainder, less losses in the coupler, to convertor 44. Convertors 42, 44 can comprise photodiodes, and preferably comprise gallium arsenide photodiodes to provide preferred high voltage output and high conversion efficiency. Convertor 44 is coupled to a power converter circuit 46 which converts, in one preferred embodiment, the relatively low voltage output (about 0.9 volts) of convertor 44 to a higher voltage output 48A, 48B (3.5 to 5 volts) suitable for energizing MOS circuits. Alternatively, converter 44 can comprise several photodiodes connected in series to provide the higher voltage, making power convertor 46 unnecessary. The output 48A, 48B is applied to sensor circuit 50 for energizing the sensor circuit. Sensor circuit 50 preferably comprises MOS circuitry and a process variable sensor sensing process variable 12. Sensor circuit 50 provides electrical output 52A, 52B indicative of a magnitude of process variable 12. Convertor 42 senses the modulated component of light on waveguide 14 and couples an electrical signal representative of the modulation to circuit 50 via line 54. A driver circuit 56 is energized from lines 48A, 48B and controlled by output on lines 52A, 52B to modulate emitter 58, which can be a light emitting diode. Emitter 58 couples an optical or light output of transmitter 10 along waveguide 16 back to interface 18. The embodiment shown in FIG. 1 enables control system 24 to program transmitter 10 with span, Zero, temperature correction data, and the like, and receive a programmed transmitter output back from transmitter 10 without the need for electrical connections or power sources of any kind other than through waveguide 14 to transmitter 10. All of the power for transmitter 10 is provided by the optical waveguide 14.

In FIG. 2, a further preferred embodiment of an optical communication system is shown. Components with reference numbers corresponding to components previously described perform the same functions. In FIG. 2, a single waveguide 62 couples transmitter 60 to interface 66 which in turn couples to control system 68. Interface 66 includes a coupler 70 which couples light generator 26 and light receiver 32 to waveguide 62.

Light output by light generator 26 preferably is at a wavelength (e.g., 800 nanometer) different from the wavelength (e.g., 660 nanometer) of light output from transmitter 60. In this case, coupler 70 is preferably a dichroic mirror which enhances the optical throughput of the system and optical filter 72 can be used to filter out residual light originating from the light generator 26.

In FIG. 2, a device 64 couples to single waveguide 62 to receive light from light generator 26 and also transmits the transmitter light output to interface 66 through waveguide 62. Device 64 comprises a gallium arsenide photodiode which provides an electrical output on line 74 coupling to power converter 46. The output on line 74 is also capacitively coupled along line 76 to provide the modulated component of received light to the sensor circuit 50. Device 64 further comprises a light emitting diode driven by driver 56. The embodiment in FIG. 2 provides communication and energization as in FIG. 1, however, in FIG. 2 this is achieved with a single waveguide between transmitter 60 and interface 66. Various combinations of uses of couplers and extracting modulation shown in FIGS. 1 and 2 can be used to achieve the same resulting energization and communication. In FIGS. 1 and 2, the light generator 26 provides all of the energization for the transmitter, and there is no need for separate sources of power such as wires, batteries, or solar cells. Electrical circuitry in the transmitter and light modulation in the transmitter is solely powered by light received from a waveguide.

In FIG. 3, a circuit diagram of power converter 46 is illustrated coupled to a gallium arsenide photodiode 80 receiving light for energization from waveguide 82. Photodiode 80, in turn, energizes a free running multivibrator circuit 84. The multivibrator circuit 84 generates a pair of oscillatory outputs 86A, 86B which are electrically out of phase with one another. Photodiode 80 also energizes a step up transformer type power supply 88. The outputs 86A, 86B are coupled to transistors 90A, 90B respectively driving a primary winding of transformer 92. A secondary winding 92A of transformer 92 is coupled to full wave rectifier 94 to provide a voltage output 96 (3.5 to 5 volts) higher than the voltage used to energize the converter 46, typically 0.9 volts from gallium arsenide photodiode 80. Transistors 90A, 90B, 98 can be germanium type transistors to achieve operation at even lower voltages.

In FIG. 4, a solid state or semiconductor device 64A is shown providing the function of device 64 of FIG. 2 or the function of convertors 42, 44 and coupler 38 in FIG. 1. In FIG. 4, a light emitting diode 106 generates a light output at a first wavelength. Layers 102, 104 are formed of materials which are substantially transparent at the first wavelength. Light output from light emitting diode 106 couples through layers 102, 104 to waveguide 100 forming the light output from the transmitter. Layer 104 comprises a photodiode sensor for sensing modulation and corresponds to convertor 42 in FIG. 1. Layer 102 comprises a sensor for providing electrical energization and corresponds to convertor 44 in FIG. 1. The light for energization is at a second wavelength different than the first wavelength, and the light for modulation is at a third wavelength different from the first' and second wavelengths. The sensors in layers 102, 104 are correspondingly wavelength selective so that separate modulation and power outputs are generated on leads 108. Alternatively, energization and modulation can be at the same wavelength, diode 104 can be eliminated and modulation and power can both be detected by a single photodiode on layer 102.

In FIG. 5, another device 110 for use in transceiving light in a transmitter is shown which receives and transmits light to a waveguide 112. Gallium arsenide photodiode 114 receives light for energizing the transmitter and converts it to electrical energy. Photodiode 116 receives light and provides the modulation signal. As explained above, photodiode 116 can be left out when the modulation signal is taken from photodiode 114 as in FIG. 2. The light output of the transmitter can be generated by a light emitting diode 118 disposed at location 118A, 118B, or 118C. For location 118B, a port 120 through the photodiode 114 allows light from the light emitting diode at 118B to reach the waveguide 112. For location 118C, the light from LED 118 is reflected from the photodiode 114 into the waveguide 112. The shapes of the photodiode surfaces 114, 115, 118A and their arrangement can be any arrangement convenient for coupling light to and from waveguide 112. Preferably, the active elements substantially fill the light capture angle (numerical aperture) of the waveguide to reduce losses. Active areas can be concentric rings, sectors of a circle or an arbitrary shape.

In FIG. 6, a "multidrop" arrangement of transmitter 60A, 608, 60C coupling to a single waveguide 62 is shown. Interface 66 (shown in FIG. 2) couples enough light to the waveguide 62 to provide all of the energization for multiple transmitters. The light outputs of each of the transmitters is formed as a digital word which includes an address identifying the transmitter to the interface 66. Likewise, the modulated output from light converter 26 (shown in FIG. 2) comprises digital words which include an address identifying the transmitter which is to receive and respond to the digital word. In FIG. 7, a further alternative embodiment of a multidrop arrangement of a plurality of transmitters 60D, 60E, 60F coupling along a single waveguide 62 to an interface 66 (shown in FIG. 2). The light outputs from each transmitter can comprise serial digital data in a selected multidrop digital protocol such as the HART digital protocol of Rosemount Inc.

In FIG. 8, a further embodiment of a multidrop arrangement of transmitters 60G, 60H, 60J coupling via waveguide 62 to interface 66 (shown in FIG. 2) is shown. In FIG. 8, wavelength division couplers 130A, 1308, 130C in each transmitter provide optically separated coupling paths for the excitation and modulation at one wavelength and the transmitter light output at a second wavelength different than the first. Many known wavelength coding and decoding arrangements can be used, and many known electrical communication protocols, including half duplex and full duplex arrangements can be adapted for use in optical communication over the optical media.

Claims

1. A transmitter (10, 60) having a light input energizing the transmitter and providing a light output to an optical medium (16, 62, 100, 112) indicating a process variable (12) comprising:

   sensor means (50) for generating an electrical sensor output (52A; 52B) representative of the process variable (12);
   circuit means (56) receiving the sensor output for generating an electrical transmitter output indicating the process variable (12), the circuit means having an energization input (48A, 48B) for energizing the circuit means (50); and
   conversion means (58, 64, 64A, 110, 118) for converting the transmitter output to the light output, the conversion means further including receiver means (42, 44, 46, 64, 64A) receiving light for converting the received light into electrical energy provided to the energization input;

   wherein

   the circuit means (50) is adapted to adjust the electrical transmitter output indicating the process variable (12) by a changeable parameter stored in the circuit means;
   and the receiver means (42, 44, 46, 64, 64A) is adapted to convert a first portion of the received light into electrical energy provided to the energization input and to convert a second portion of the received light into an electrical output controlling the changeable parameter stored in the circuit means (50).

2. The transmitter of claim 1 wherein the changeable parameter comprises a changeable measurement range of the process variable.

3. The transmitter of claim 1 wherein the receiver means (42, 44, 45, 64, 64A) receive the received light from a waveguide (14, 62, 100, 112).

4. The transmitter of claim 3 wherein the conversion means (58, 64, 64A) include an emitter surface (106, 114, 118) emitting light and the receiver means (42, 44, 46, 64, 64A) include a receiving surface (102, 104, 114, 116) for converting the received light.

5. The transmitter of claim 4 wherein the waveguide (14, 62, 100, 112) receives and transmits light within a light capture angle.

6. The transmitter of claim 5 wherein the emitting surface (106, 114, 118) and the receiving surface (102, 104, 114, 116) substantially fill the light capture angle of the waveguide (100, 112).

7. The transmitter of claim 6 wherein the receiving surface (102, 104, 114) is disposed along a light path between the waveguide (100, 112) and the emitting surface (106, 118B, 118C), the receiving surface (102, 104, 114) being arranged to permit light to pass along the path from the emitting surface (106, 118B, 118C) to the waveguide (100, 112).

8. The transmitter of claim 7 wherein the receiving surface (114) has a port (120) therethrough for passing the light from the emitting surface (118B).

9. The transmitter of claim 7 wherein the receiving surface (102, 104) is at least partially transparent to pass light from the emitting surface (106).

10. The transmitter of claim 7 wherein the receiving surface (114) reflects light from the emitting surface (118C) to the waveguide (112).

11. The transmitter of claim 1 wherein the received light represents a function of a desired span setting and the parameter stored in the circuit means is a function of the desired span setting programmed by the received light.

12. The transmitter of claim 1 wherein the received light represents a linearity correction of the transmitter output and the parameter stored in the circuit means is a function of the linearity correction programmed by the received light.

13. The transmitter of claim 1 wherein the received light represents a temperature correction of the transmitter output and the parameter stored in the circuit means is a function of the temperature correction programmed by the received light.

14. An interface (18, 66) for use between an optical medium communicating with a remote optical process variable transmitter (10, 60) and an electrical bus (22) comprising:

   light generating means (26) for coupling to a waveguide (14, 62, 100, 112) and including means (28) for generating an energizing light component to energize the transmitter;
   control means (28) coupled to the light generating means (26) for electrically controlling am-

plitude of the energizing light component as a function of a reference in the control means; and receiver means (32) for providing an electrical output to the bus (22) representative of the optical output received from the transmitter;

characterized in that:

the light generating means (26) includes means (30) for generating a programming light component modulated to program a changeable parameter to scale an optical output of the transmitter;
and the control means (28) is adapted to electrically control the modulation as a function of a further reference received from the bus (22).

15. The interface (66) of claim 14 wherein the waveguide (62) couples to a plurality of optical process variable transmitters (60A-C, 60D-F, 60G-J) and the first means further comprises means for generating a programming light component modulated to program generation of optical outputs by the plurality of transmitters (60A-C, 60D-F, 60G-J).

16. The interface (66) of claim 15 wherein the energizing light component energizes the plurality of optical process control transmitters (60A-C, 60D-F, 60G-J).

17. The interface (66) of claim 16 wherein the programmed optical output is coupled along the waveguide (62).

18. The interface (66) of claim 17 wherein the receiver converts the programmed optical outputs from a plurality of optical process transmitters to a common electrical bus.

Patentansprüche

1. Sender (10, 16), welcher mit Hilfe eines Lichteingangssignals erregt wird und ein Lichtausgangssignal an ein eine Prozeßvariable anzeigendes optisches Gerät (16, 62 100, 112) sendet und folgendes aufweist:

eine Meßvorrichtung (50) für das Erzeugen eines elektrischen Ausgangssignals des Meßfühlers (52A; 52B), welches die Prozeßvariable (12) darstellt;

eine Schaltkreisvorrichtung (56), welche das Ausgangssignal des Meßfühlers empfängt und das elektrische Ausgangssignal des Senders, welches die Prozeßvariable (12) anzeigt, erzeugt, wobei die Schaltvorrichtung Erregereingangssignale (48A, 48B) für das Erregen der Schaltvorrichtung (50) aufweist; und

eine Umwandlungsvorrichtung (58, 64, 64A, 110, 118) für das Umwandeln des Ausgangssignals des Senders in das Lichtausgangssignal, wobei die Umwandlungsvorrichtung weiter eine Empfangsvorrichtung (42, 44, 46, 64, 64A) aufweist, welche Licht für das Umwandeln in elektrische Energie aufnimmt, welche dann an das Erregereingangssignal weitergegeben wird;

dadurch gekennzeichnet, daß

die Schaltkreisvorrichtung (50) so angepaßt ist, daß das elektrische Ausgangssignal des Senders, welches die Prozeßvariable (12) anzeigt, mit Hilfe eines in der Schaltkreisvorrichtung gespeicherten veränderbaren Parameters, eingestellt wird;

und die Empfangsvorrichtung (42, 44, 46, 64, 64A) so angepaßt ist, daß ein erster Teil des aufgenommenen Lichts in elektrische Energie umgewandelt wird und an das Erregereingangssignal weitergegeben wird und weiter ein zweiter Teil des empfangenen Lichts in ein elektrisches Ausgangssignal umgewandelt wird, das den in der Schaltkreisvorrichtung (50) gespeicherten veränderbaren Parameter steuert.

2. Sender nach Anspruch 1, dadurch gekennzeichnet, daß der veränderbare Parameter einen veränderbaren Meßbereich der Prozeßvariablen aufweist.

3. Sender nach Anspruch 1, dadurch gekennzeichnet, daß die Empfangsvorrichtung (42, 44, 46, 64, 64A) das aufgenommene Licht von einem Wellenleiter (14, 62, 100, 112) empfängt.

4. Sender nach Anspruch 3, dadurch gekennzeichnet, daß die Umwandlungsvorrichtung (58, 64, 64A) eine Sendeoberfläche (106, 114, 118) aufweist, welche Licht aussendet und die Empfangsvorrichtung (42, 44, 46, 64, 64A) eine Empfangsoberfläche (102, 104, 114, 116) für das Umwandeln des aufgenommenen Lichts aufweist.

5. Sender nach Anspruch 4, dadurch gekennzeichnet, daß der Wellenleiter (14, 62, 100, 112) das Licht innerhalb eines Lichterfassungswinkels aufnimmt und weiterleitet.

6. Sender nach Anspruch 5, dadurch gekennzeichnet, daß die Sendeoberfläche (106, 114, 118) und die Empfangsoberfläche (102, 104, 114, 116) im wesentlichen den Lichterfassungswinkel des Wellenleiters (100, 112) ausfüllen.

7. Sender nach Anspruch 6, dadurch gekennzeichnet, daß die Empfangsoberfläche (102, 104, 114) entlang eines Lichtpfades zwischen dem Wellenleiter (100, 112) und der Sendeoberfläche (106, 118B, 118C) angeordet ist, wobei die Empfangsoberfläche (102, 104, 114) so angeordnet ist, daß Licht entlang des Lichtpfades von der Sendeoberfläche (106, 118B, 118C) zum Wellenleiter (100, 112) gelangen kann.

8. Sender nach Anspruch 7, dadurch gekennzeichnet, daß die Empfangsoberfläche (114) einen Lichteinlaß (120) aufweist, durch welchen das Licht von der Sendeoberfläche (118B) gelangen kann.

9. Sender nach Anspruch 7, dadurch gekennzeichnet, daß die Empfangsoberfläche (102, 104) zumindest zum Teil transparent ist und Licht von der Sendeoberfläche (106) hindurchläßt.

10. Sender nach Anspruch 7, dadurch gekennzeichnet, daß die Empfangsoberfläche (114) Licht von der Sendeoberfläche (118C) zum Wellenleiter (112) reflektiert.

11. Sender nach Anspruch 1, dadurch gekennzeichnet, daß das aufgenommene Licht eine Funktion einer gewünschten Meßbereichseinstellung ist und der in der Schaltkreisvorrichtung gespeicherte Parameter eine Funktion der gewünschten Meßbereichseinstellung ist, welche mit Hilfe des aufgenommenen Lichts programmiert wird.

12. Sender nach Anspruch 1, dadurch gekennzeichnet, daß das aufgenommene Licht eine Linearitätskorrektur des Ausgangssignals des Senders darstellt und der in der Schaltkreisvorrichtung gespeicherte Parameter eine Funktion der Linearitätskorrektur ist, welche mit Hilfe des aufgenommenen Lichts programmiert wird.

13. Sender nach Anspruch 1, dadurch gekennzeichnet, daß das aufgenommene Licht eine Temperaturkorrektur des Ausgangssignals des Senders darstellt und der in der Schaltkreisvorrichtung gespeicherte Parameter eine Funktion der Temperaturkorrektur ist, welche mit Hilfe des aufgenommenen Lichts programmiert wird.

14. Schnittstelle (18, 66) für den Gebrauch zwischen einem optischen Medium mit einem ferngesteuerten optischen Prozeßvariablen-Sender (10, 60) und einer elektrischen Sammelschiene (22), wobei die Schnittstelle folgendes aufweist:

eine Lichterzeugungsvorrichtung (26) zur Koppelung an einen Wellenleiter (14, 62, 100, 112) mit einer Zusatzvorrichtung (28) für das Erzeugen eines erregenden Lichtbestandteils zur Erregung des Senders;

eine Steuervorrichtung (28), welche an die Lichterzeugungsvorrichtung (26) gekoppelt ist und zur elektrischen Steuerung der Amplitude des erregenden Lichtbestandteils als Funktion einer Vergleichsgröße in der Steuervorrichtung dient;

und eine Empfangsvorrichtung (32) für das Liefern eines elektrischen Ausgangssignals an die Sammelschiene (22), welches das optische Ausgangssignal vom Sender darstellt;

dadurch gekennzeichnet, daß

die Lichterzeugungsvorrichtung (26) eine Vorrichtung (30) zur Erzeugung eines programmierenden Lichtbestandteils aufweist, welcher so moduliert ist, daß er einen veränderbaren Parameter zur Erfassung eines optischen Ausgangssignals vom Sender programmiert;

und die Steuervorrichtung (28) so angepaßt ist, daß die Modulation als Funktion einer weiteren von der Sammelschiene (22) empfangenen Vergleichsgröße elektrisch gesteuert wird.

15. Schnittstelle (66) nach Anspruch 14, dadurch gekennzeichnet, daß der Wellenleiter (62) eine Vielzahl von optischen Prozeßvariablen-Sendern (60A-C, 60D-F, 60G-J) koppelt und die erste Vorrichtung weiter eine Vorrichtung für das Erzeugen eines programmierenden Lichtbestandteils aufweist, welche so moduliert ist, daß die Erzeugung eines optischen Ausgangssignals durch eine Vielzahl von Sendern (60A-C, 60D-F, 60G-J) programmiert wird.

16. Schnittstelle (66) nach Anspruch 15, dadurch gekennzeichnet, daß der erregende Lichtbestandteil die Vielzahl von optischen Prozeßvariablen-Sendern (60A-C, 60D-F, 60G-J) erregt.

17. Schnittstelle (66) nach Anspruch 16, dadurch gekennzeichnet, daß das programmierte optische Ausgangssignal entlang des Wellenleiters (62) gekoppelt ist.

18. Schnittstelle (66) nach Anspruch 17, dadurch gekennzeichnet, daß die Empfangsvorrichtung die programmierten optischen Ausgangssignale von einer Vielzahl von optischen Prozeßsendern in eine herkömmliche elektrische Sammelschiene umwandelt.

Revendications

1. Emetteur/récepteur (10, 60) ayant une entrée de lumière mettant sous tension l'émetteur/récepteur et fournissant une sortie de lumière vers un support optique (16, 62, 100, 112) indiquant une variable de traitement (12), comportant :

   des moyens de détecteur (50) pour produire une sortie électrique de détecteur (52A ; 52B) représentative de la variable de traitement (12), des moyens de circuit (56) recevant la sortie de détecteur pour produire une sortie électrique d'émetteur/récepteur indiquant la variable de traitement (12), les moyens de circuit ayant une entrée de mise sous tension (48A, 48B) pour mettre sous tension les moyens de circuit (56), et

   des moyens de conversion (58,64, 64A, 110, 118) pour convertir la sortie de l'émetteur/récepteur en sortie de lumière, les moyens de conversion comportant de plus des moyens de récepteur (42, 44, 46, 64, 64A) recevant une lumière pour convertir la lumière reçue en énergie électrique envoyée à l'entrée de mise sous tension,

   dans lequel

   les moyens de circuit (56) sont adaptés pour ajuster la sortie électrique de l'émetteur/récepteur indiquant la variable de traitement (12) par un paramètre pouvant être modifié mémorisé dans les moyens de circuit,

   et les moyens de récepteur (42, 44, 46, 64, 64A) sont adaptés pour convertir une première partie de la lumière reçue en énergie électrique envoyée vers l'entrée de mise sous tension et pour convertir une seconde partie de la lumière reçue en sortie électrique commandant le paramètre pouvant être changé mémorisé dans les moyens de circuit (56).

2. Emetteur/récepteur selon la revendication 1, dans lequel le paramètre pouvant être modifié comporte une plage de mesures pouvant être modifiée de la variable de traitement.

3. Emetteur/récepteur selon la revendication 1, dans lequel les moyens de récepteur (42, 44, 46, 64, 64A) reçoivent la lumière reçue en provenance d'un guide d'onde (14, 62, 100, 112).

4. Emetteur/récepteur selon la revendication 3, dans lequel les moyens de conversion (58, 64, 64A) comportent une surface émettrice (106, 114, 118) émettant une lumière et les moyens de récepteur (42, 44, 46, 64, 64A) comportent une surface réceptrice (102, 104, 114, 116) pour convertir la lumière reçue.

5. Emetteur/récepteur selon la revendication 4, dans lequel le guide d'onde (14, 62, 100, 112) reçoit et transmet une lumière dans un angle de capture de lumière.

6. Emetteur/récepteur selon la revendication 5, dans lequel la surface émettrice (106, 114, 118) et la surface réceptrice (102, 104, 114, 116) remplissent pratiquement l'angle de capture de lumière du guide d'onde (100, 112).

7. Emetteur/récepteur selon la revendication 6, dans lequel la surface réceptrice (102, 104, 114) est disposée le long d'un trajet de lumière entre le guide d'onde (100, 112) et la surface émettrice (106, 118B, 118C), la surface réceptrice (102, 104, 114) étant agencée pour permettre à la lumière de passer le long du trajet depuis la surface émettrice (106, 118B, 118C) vers le guide d'onde (100, 112).

8. Emetteur/récepteur selon la revendication 7, dans lequel la surface réceptrice (114) a un orifice traversant (120) pour laisser passer la lumière provenant de la surface émettrice (118B).

9. Emetteur/récepteur selon la revendication 7, dans lequel la surface réceptrice (102, 104) est au moins partiellement transparente pour laisser passer la lumière provenant de la surface émettrice (106).

10. Emetteur/récepteur selon la revendication 7, dans lequel la surface réceptrice (114) réfléchit la lumière provenant de la surface émettrice (118C) vers le guide d'onde (112).

11. Emetteur/récepteur selon la revendication 1 dans lequel la lumière reçue représente une fonction d'un réglage d'étendue voulu et le paramètre mémorisé dans les moyens de circuit est une fonction du réglage d'étendue voulu programmé par la lumière reçue.

12. Emetteur/récepteur selon la revendication 1, dans lequel la lumière reçue représente une correction de linéarité de la sortie de l'émetteur/récepteur et le paramètre mémorisé dans les moyens de circuit est une fonction de la correction de linéarité programmée par la lumière reçue.

13. Emetteur/récepteur selon la revendication 1, dans lequel la lumière reçue représente une correction de température de la sortie de l'émetteur/récepteur et le paramètre mémorisé dans les moyens de circuit est une fonction de la correction de température programmée par la lumière reçue.

14. Interface (18, 66) destinée à être utilisée entre un support optique communiquant avec un émetteur/récepteur éloigné (10, 60) à variable de traitement optique et un bus électrique (22), comportant :

des moyens de production de lumière (26) destinés à être couplés à un guide d'onde (14, 62, 100, 112) et comportant des moyens (28) pour produire une composante de lumière de mise sous tension pour mettre sous tension l'émetteur/récepteur,
des moyens de commande (28) couplés aux moyens de production de lumière (26) pour commander électriquement l'amplitude de la composante de lumière de mise sous tension en fonction d'une référence des moyens de commande, et des moyens de récepteurs (32) pour fournir une sortie électrique au bus (22) représentative de la sortie optique reçue en provenance de l'émetteur/récepteur,

caractérisée en ce que :

les moyens de production de lumière (26) comportent des moyens (30) pour produire une composante de lumière de programmation modulée pour programmer un paramètre pouvant être modifié pour qu'il soit à l'échelle d'une sortie optique de l'émetteur/récepteur, et
les moyens de commande (28) sont adaptés pour commander électriquement la modulation en fonction d'une autre référence reçue en provenance du bus (22).

15. Interface (66) selon la revendication 14, dans laquelle le guide d'onde (62) est couplé à plusieurs émetteurs/récepteurs (60A-C, 60D-F, 60G-J) à variable de traitement optique et les premiers moyens comportent de plus des moyens pour produire une composante de lumière de programmation modulée pour programmer la production de sorties optiques par la pluralité d'émetteurs/récepteurs (60A-C, 60D-F, 60G-J).

16. Interface (66) selon la revendication 15, dans laquelle la composante de lumière de mise sous tension met sous tension la pluralité d'émetteurs/récepteurs (60A-C, 60D-F, 60G-J) de commande de traitement optique.

17. Interface (66) selon la revendication 16, dans laquelle la sortie optique programmée est couplée le long du guide d'onde (62).

18. Interface (66) selon la revendication 17, dans laquelle le récepteur convertit les sorties optiques programmées provenant de la pluralité d'émetteurs/récepteurs de traitement optique en un bus électrique commun.

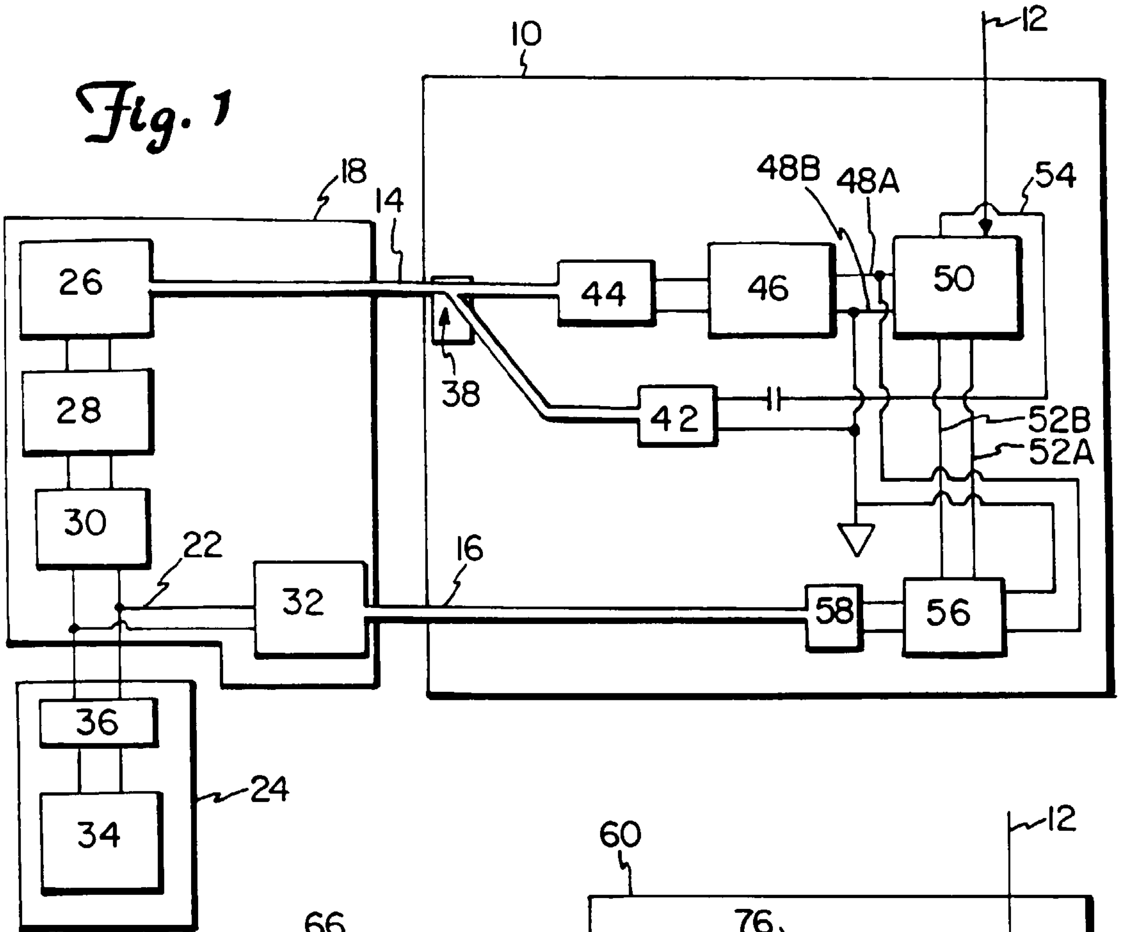

10
12
18
14
48B
48A
54
26
44
46
50
28
38
42
52B
52A
30
22
16
32
58
56
36
24
34

Fig. 1

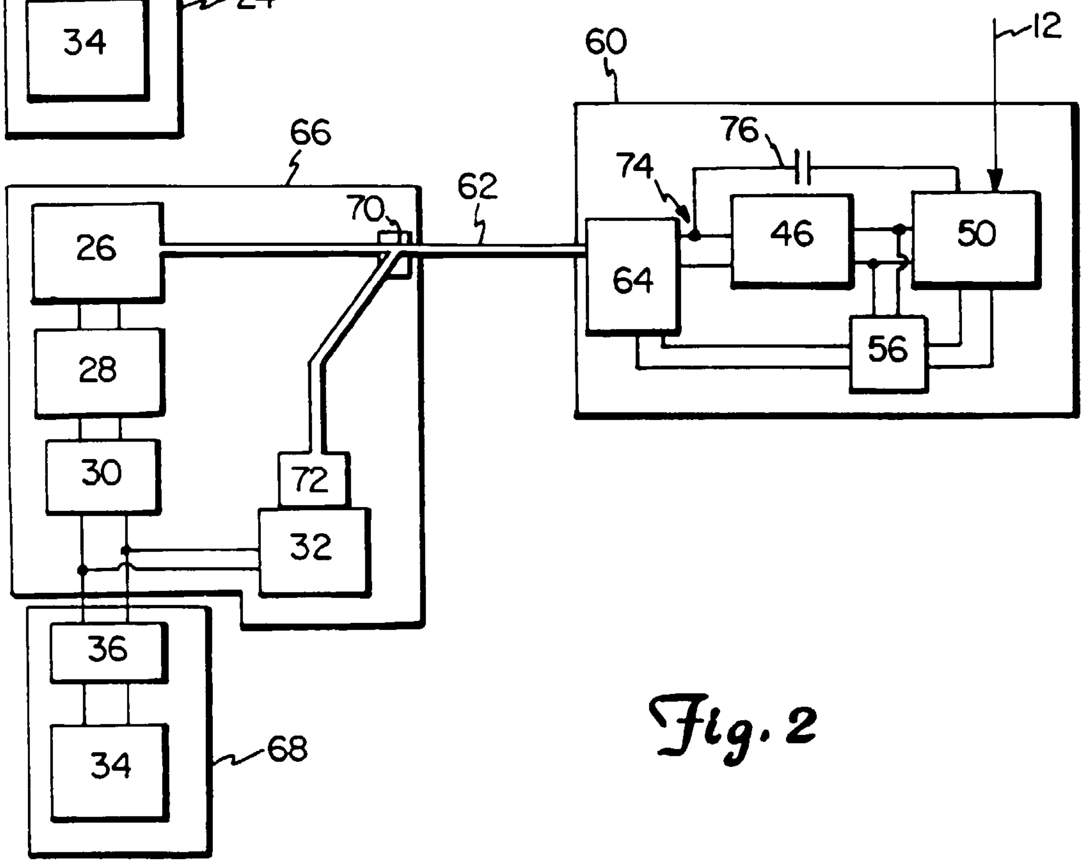
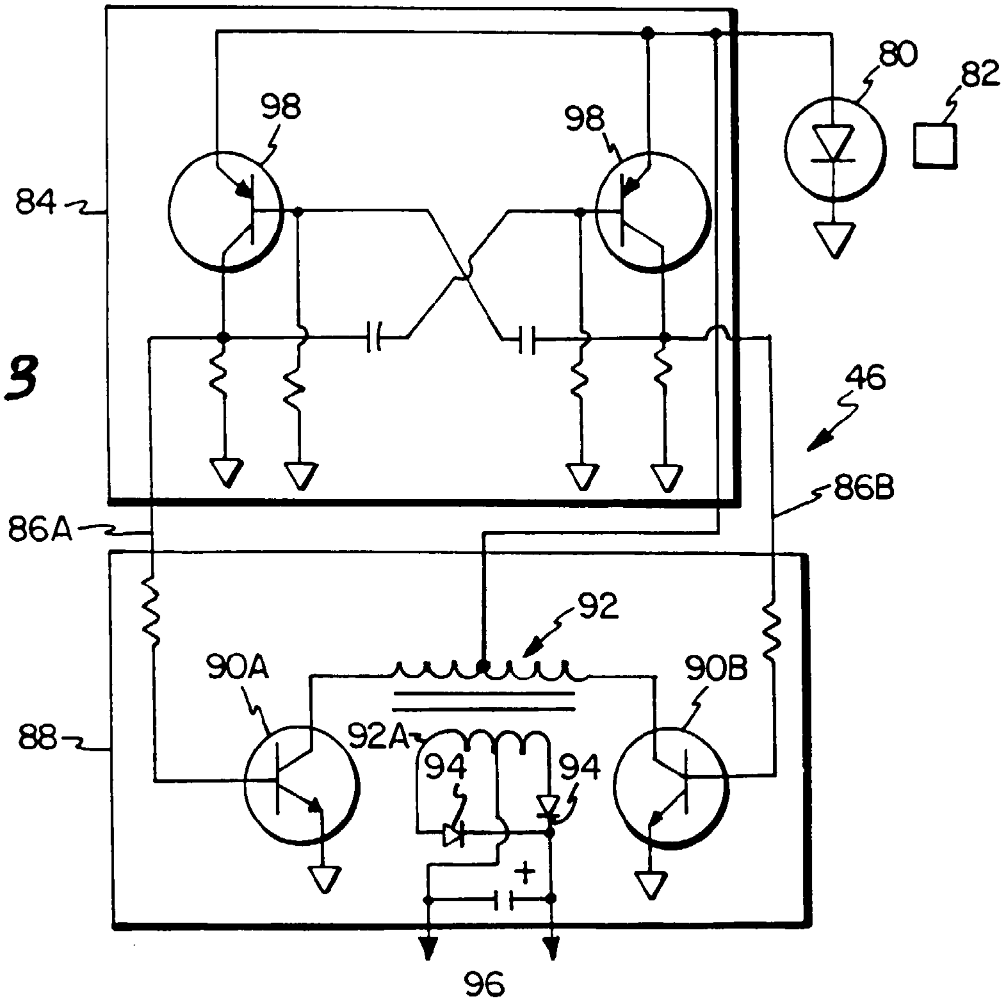

60
12
66
76
62
74
70
46
50
26
64
56
28
72
30
32
36
68
34

Fig. 2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82
98
98
84
46
86B
86A
92
90A
90B
88
92A
94
94
96

Fig. 3

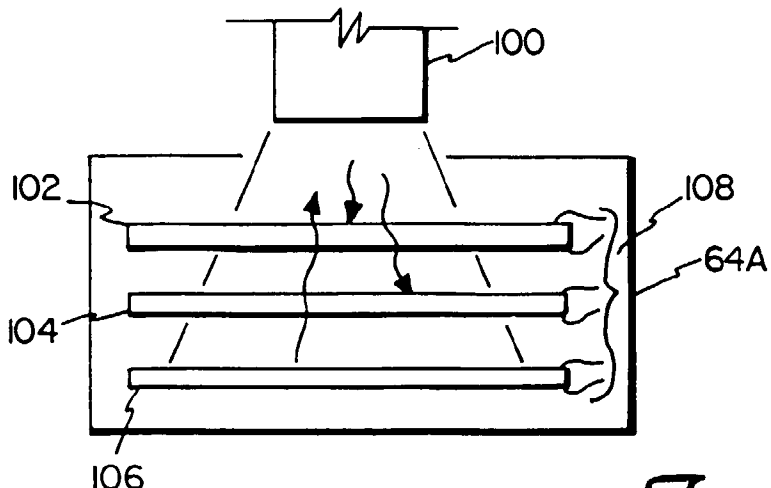
100
102
108
64A
104
106

Fig. 4

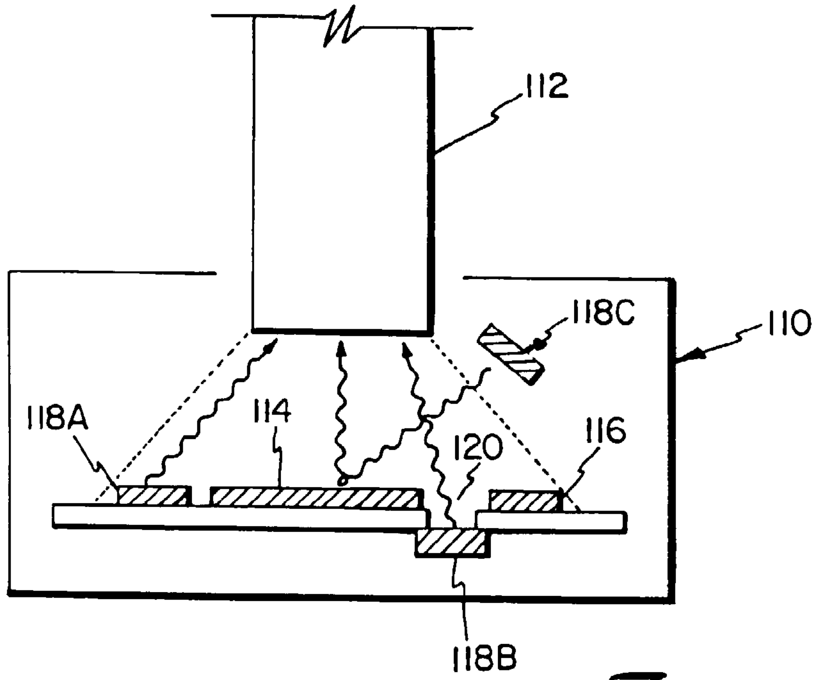
112
118C
110
118A
114
116
120
118B

Fig. 5

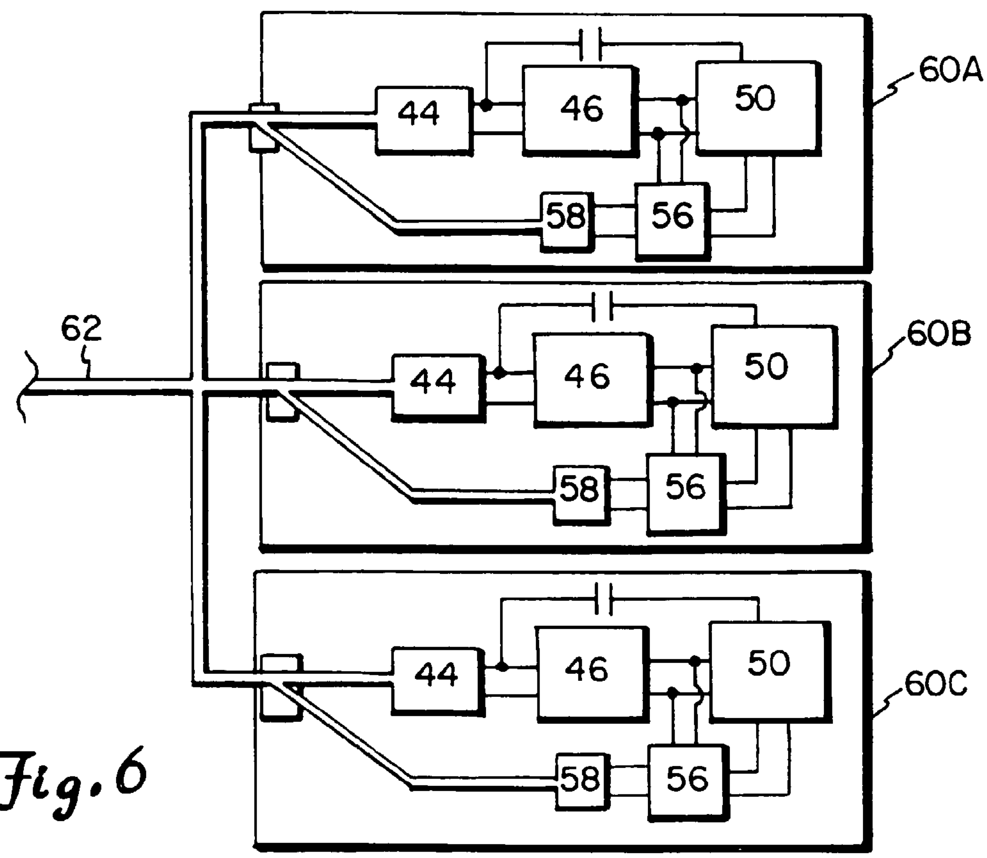
60A
44
46
50
58
56
62
60B
44
46
50
58
56
44
46
50
60C
58
56

Fig. 6

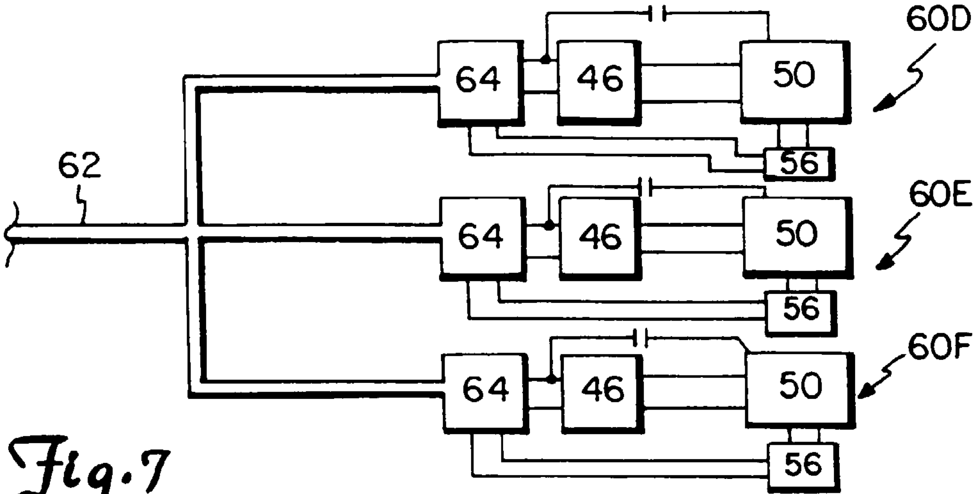
60D
64
46
50
56
62
60E
64
46
50
56
60F
64
46
50
56

Fig. 7

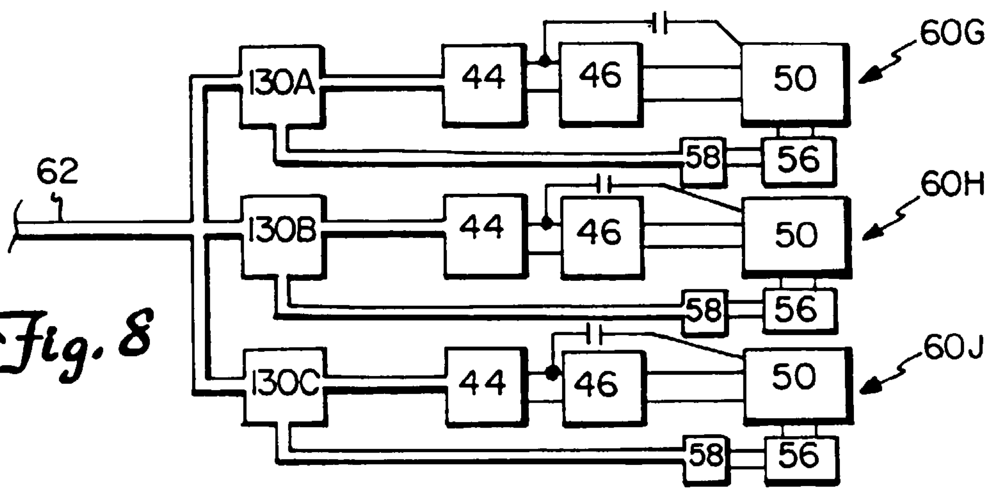
60G
130A
44
46
50
58
56
62
60H
130B
44
46
50
58
56
60J
130C
44
46
50
58
56

Fig. 8