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GB 2228641 A GB 2196202 A EP 0272750 A2
EP 0266635 A2 EP 0263233 A2 EP 0053391 A1
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(58) Field of Search
UK CL (Edition M) H4B BK BKX BK10 BK12 BK24 BK8, H4D DLFB
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ONLINE DATABASES : WPI,EDOC.

(54) Optically transmitting signals between measurement devices

(57) Each measurement device 1, 2, 3 includes a measuring unit 7a, 7b, 7c, a signal processing unit 6a, 6b, 6c each having a serial output/input interface and connected to the measuring unit for processing signals obtained by the measuring unit, and one or more photocouplers 5a, 5b, 5c, 5d, 5e, 5f connected to the serial interface of the signal processing unit for converting processed signals into the optical information. The measurement devices may be TV cameras or contacting devices. The processing units may include a CPU and memory. The measurement devices may also be connected to a central computer, which may operate a controller for equipment which assembles TV receivers and moves them down the assembly line; all connections are by optical fibres. Electromagnetic interference is eliminated by the use of optical fibres in place of electrical wires.

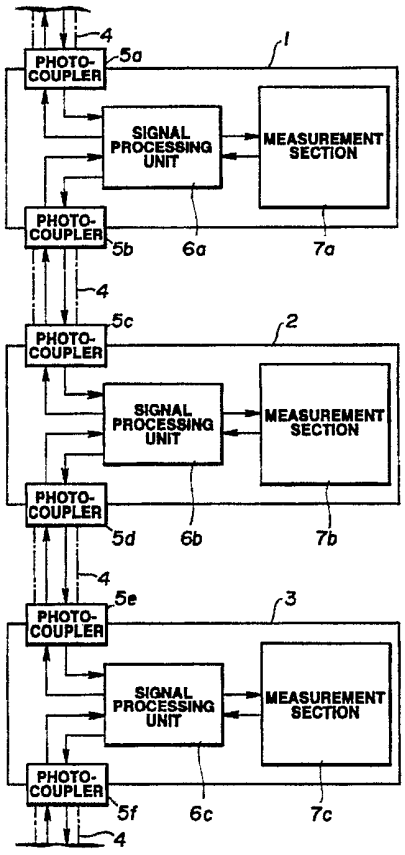

FIG.1

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

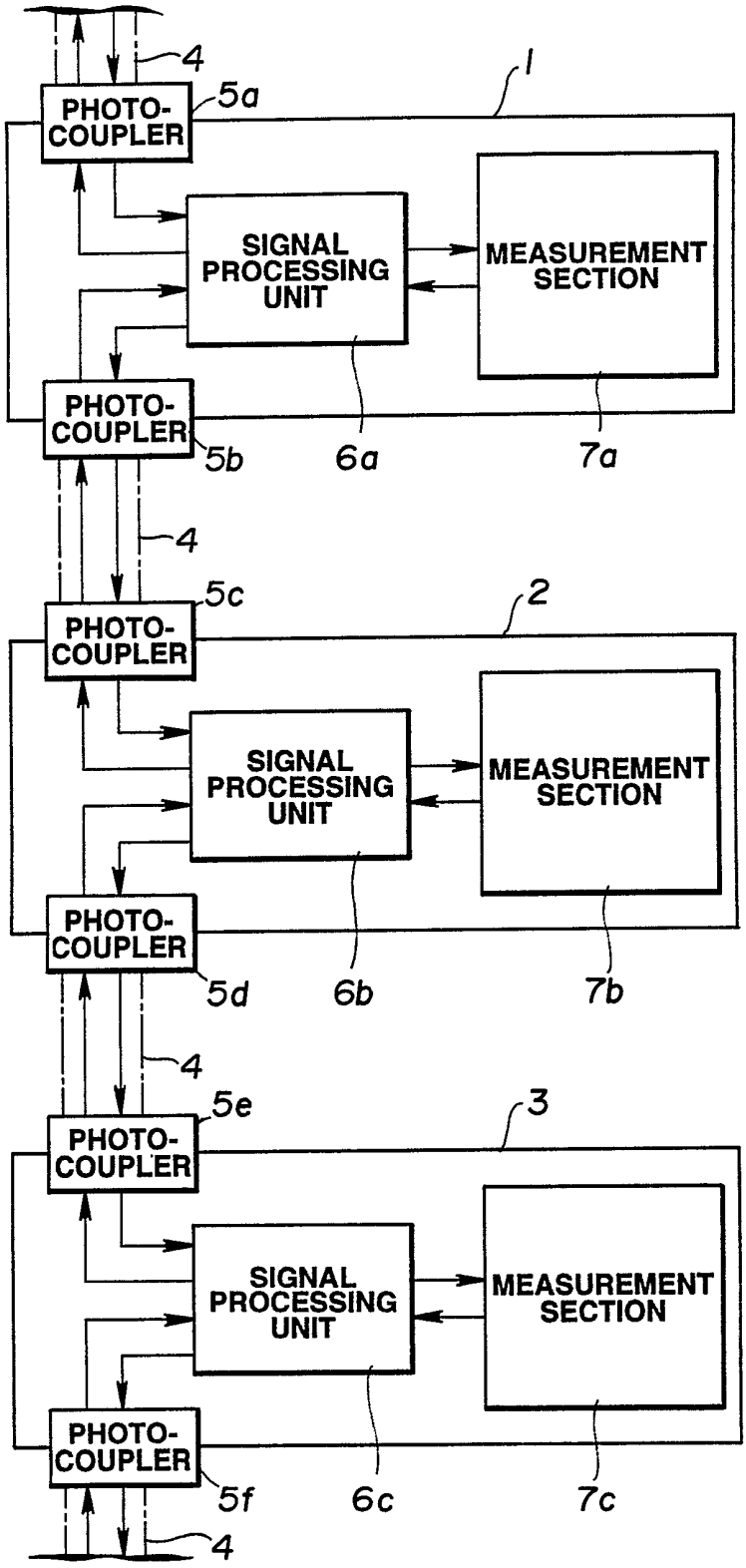
4
PHOTO-COUPLER
5a
1
SIGNAL PROCESSING UNIT
MEASUREMENT SECTION
PHOTO-COUPLER
5b
6a
7a
4
5c
2
PHOTO-COUPLER
SIGNAL PROCESSING UNIT
MEASUREMENT SECTION
PHOTO-COUPLER
5d
6b
7b
4
5e
3
PHOTO-COUPLER
SIGNAL PROCESSING UNIT
MEASUREMENT SECTION
PHOTO-COUPLER
5f
6c
7c
4

FIG.1

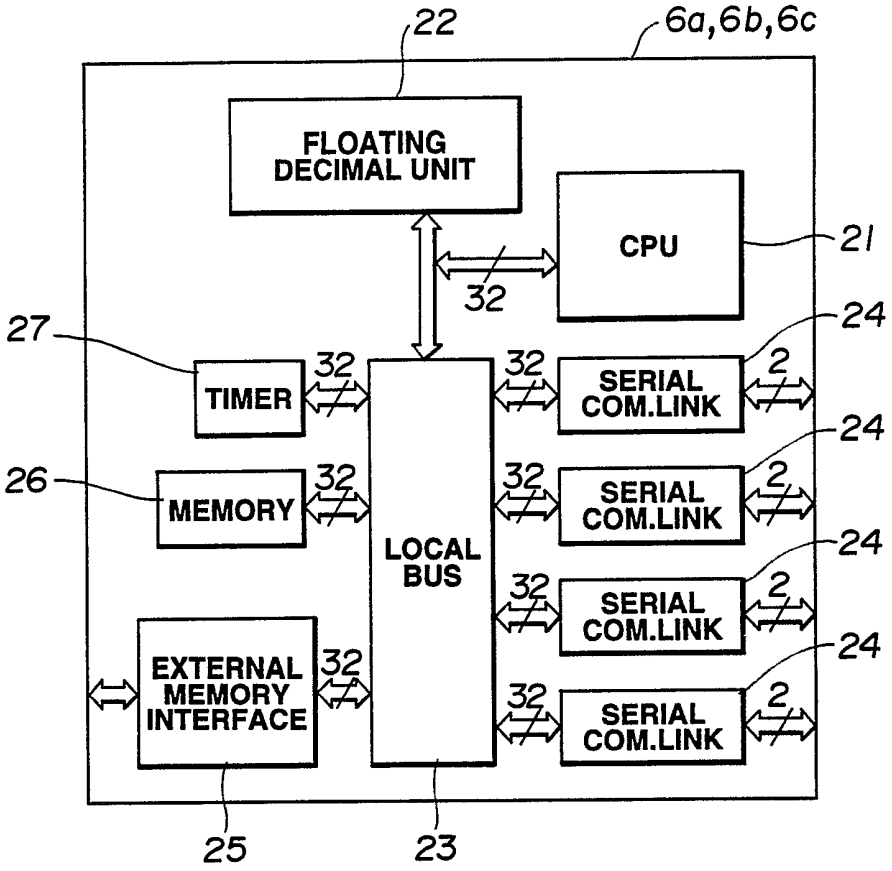
22
6a,6b,6c
FLOATING DECIMAL UNIT
CPU
21
32
27
TIMER
32
32
SERIAL COM.LINK
2
24
26
MEMORY
32
32
SERIAL COM.LINK
2
24
LOCAL BUS
32
SERIAL COM.LINK
2
24
EXTERNAL MEMORY INTERFACE
32
32
SERIAL COM.LINK
2
24
25
23

FIG.2

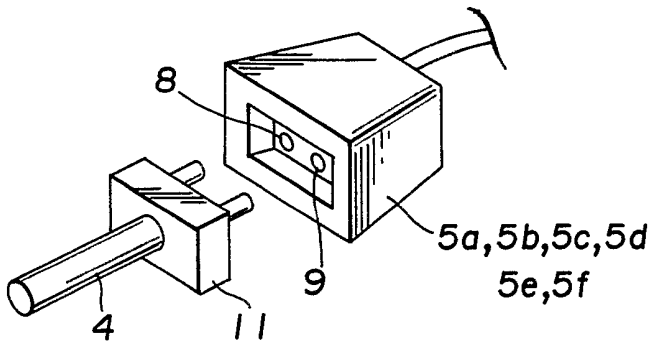
8
5a,5b,5c,5d
5e,5f
9
4
11

FIG.3

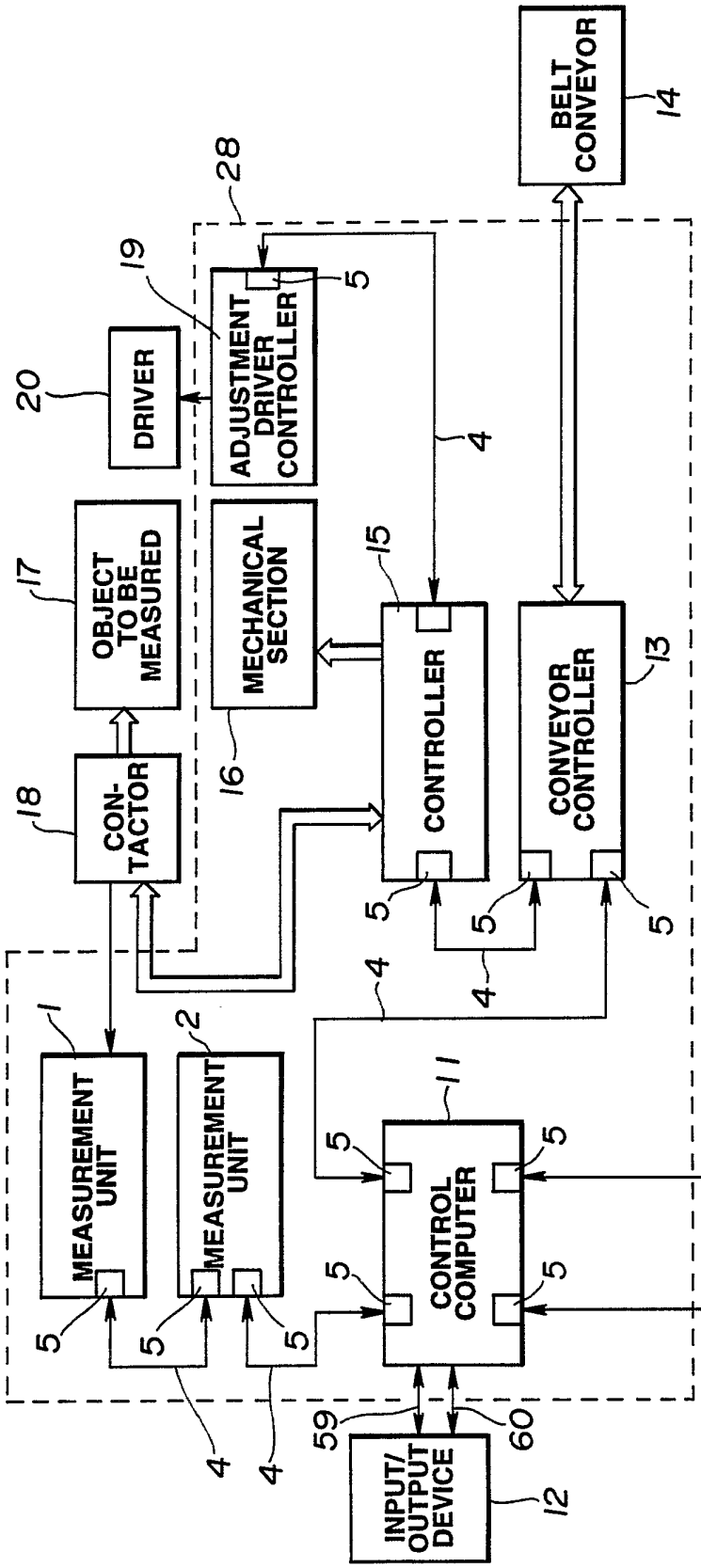
BELT CONVEYOR
14
28
19
ADJUSTMENT DRIVER CONTROLLER
5
20
DRIVER
4
17
OBJECT TO BE MEASURED
MECHANICAL SECTION
15
CONTROLLER
CONVEYOR CONTROLLER
13
18
CON-TACTOR
16
5
5
5
4
4
1
2
MEASUREMENT UNIT
MEASUREMENT UNIT
11
5
5
CONTROL COMPUTER
31
5
5
5
5
5
4
4
59
60
INPUT/ OUTPUT DEVICE
12

FIG.4

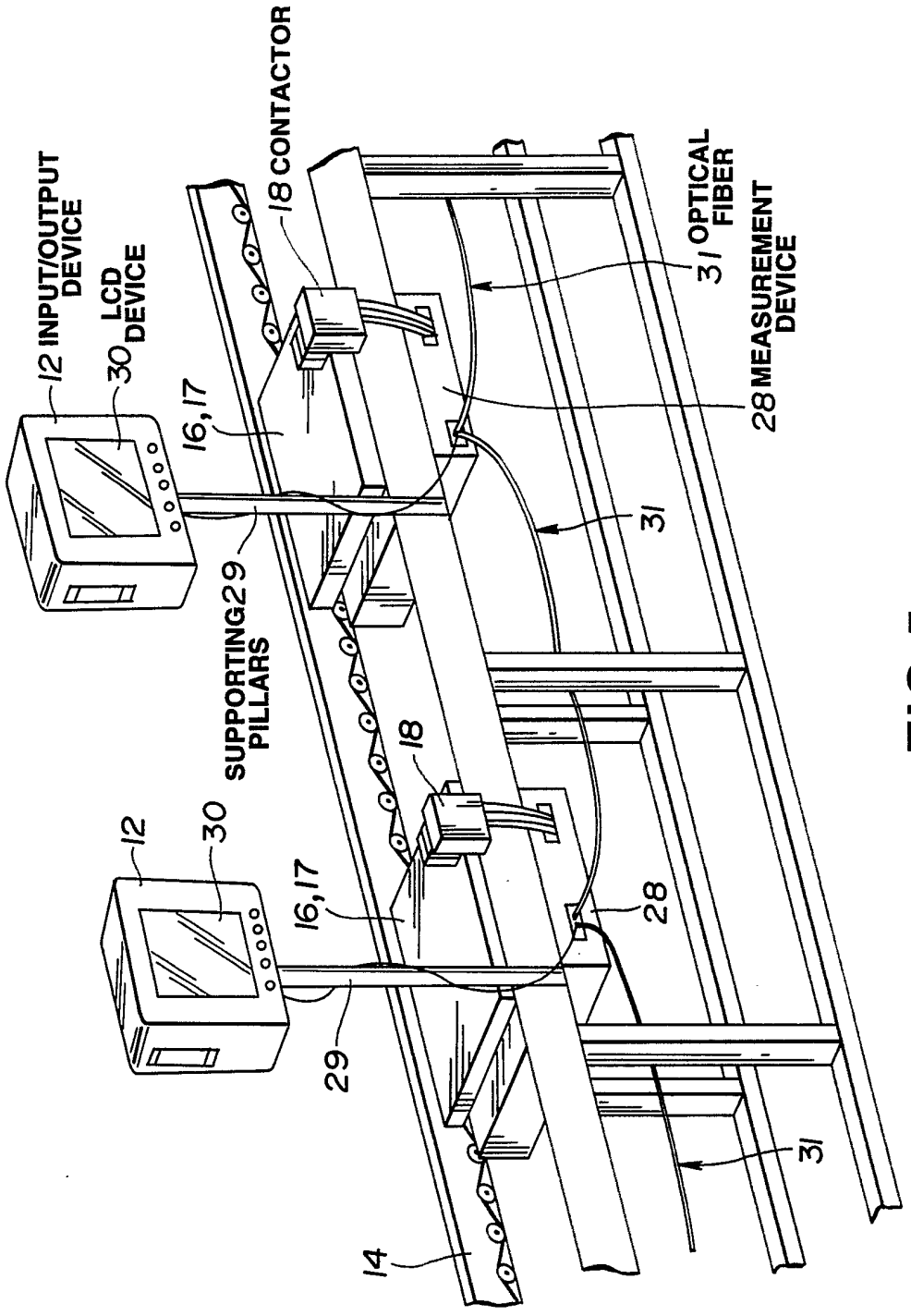
12 INPUT/OUTPUT DEVICE
30 LCD DEVICE
18 CONTACTOR
31 OPTICAL FIBER
28 MEASUREMENT DEVICE
16,17
SUPPORTING PILLARS
29
31
18
12
30
16,17
28
29
31
14

FIG.5

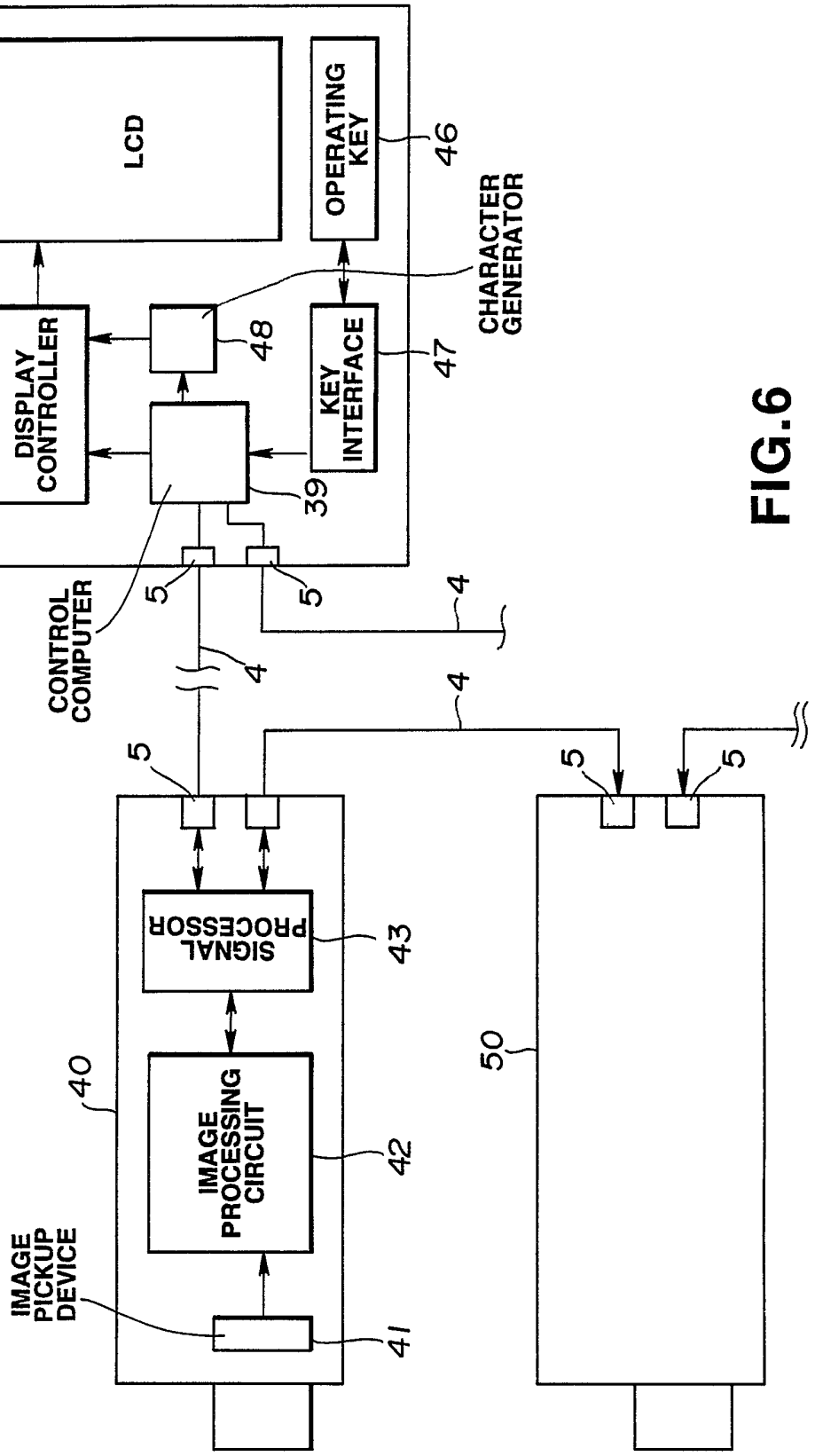
LCD
45
OPERATING KEY
46
44
CHARACTER GENERATOR
DISPLAY CONTROLLER
49
48
KEY INTERFACE
47
39
CONTROL COMPUTER
5
4
SIGNAL PROCESSOR
43
40
IMAGE PROCESSING CIRCUIT
42
IMAGE PICKUP DEVICE
41
50

FIG.6

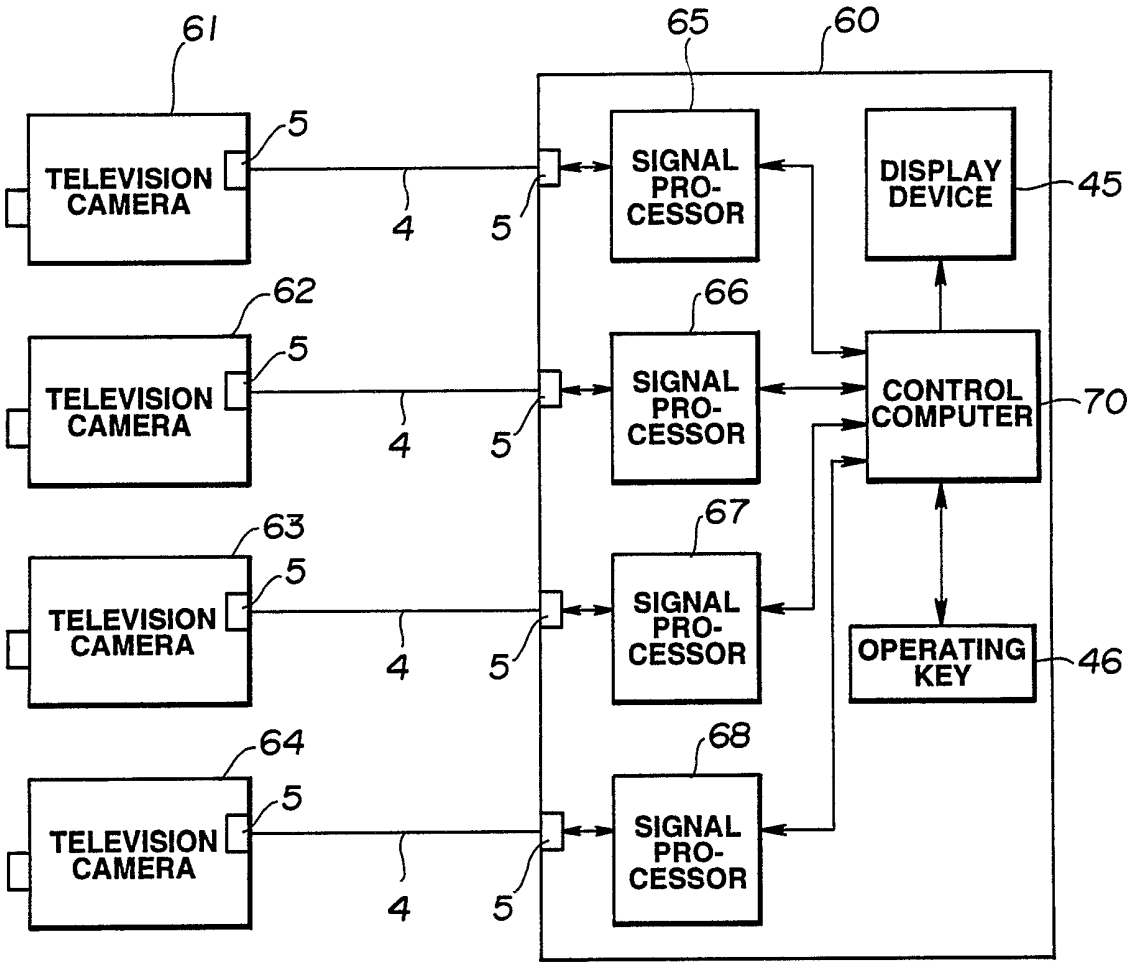
61
65
60
TELEVISION CAMERA
5
4
5
SIGNAL PRO-CESSOR
DISPLAY DEVICE
45
62
66
TELEVISION CAMERA
5
4
5
SIGNAL PRO-CESSOR
CONTROL COMPUTER
70
63
67
TELEVISION CAMERA
5
4
5
SIGNAL PRO-CESSOR
OPERATING KEY
46
64
68
TELEVISION CAMERA
5
4
5
SIGNAL PRO-CESSOR

FIG.7

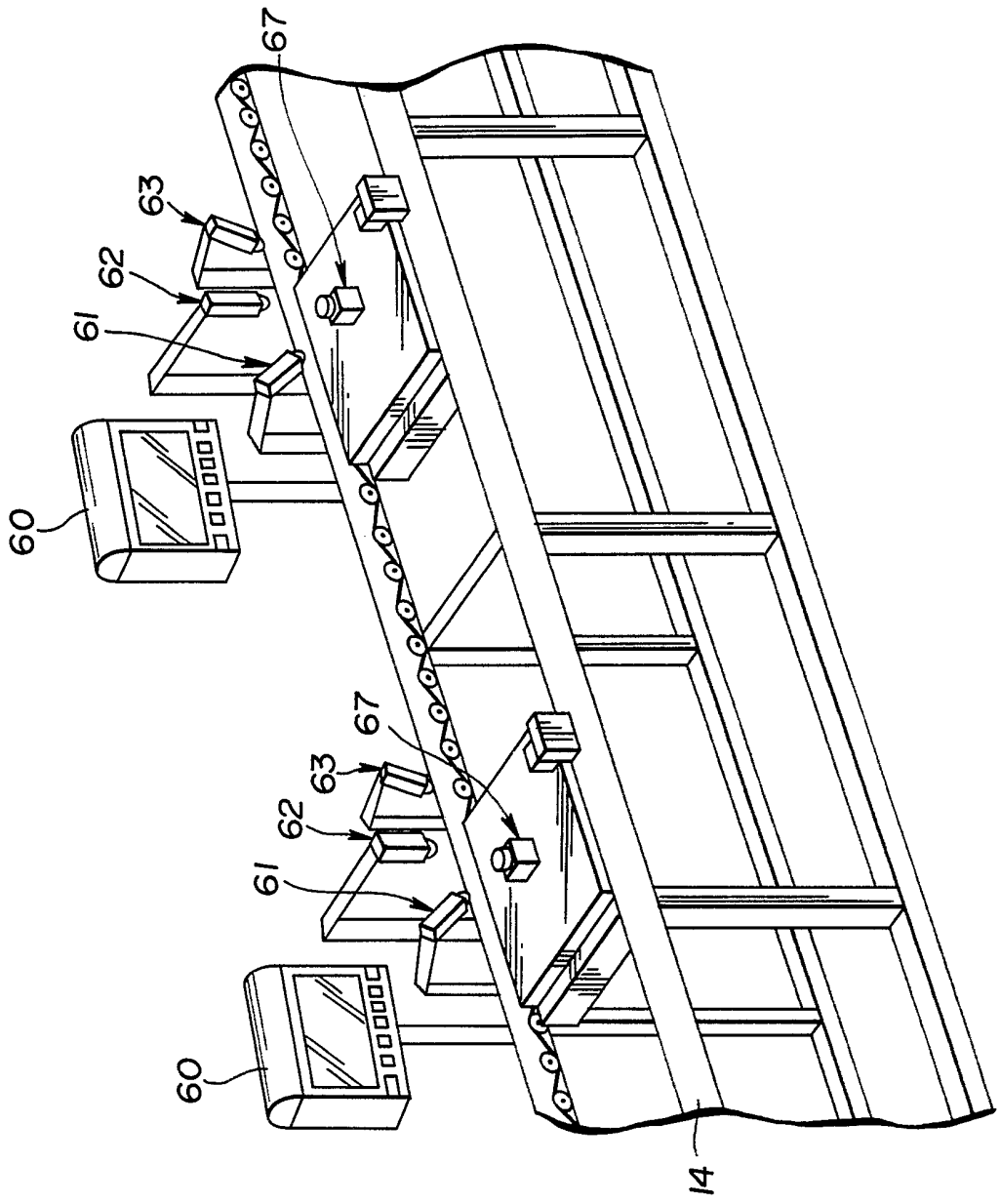

FIG.8

METHOD FOR OPTICALLY TRANSMITTING SIGNALS IN MEASUREMENT UNITS AND MEASUREMENT SYSTEM EMPLOYING THE OPTICAL TRANSMISSION METHOD

This invention relates to a method for optically transmitting signals in measurement units, and a measurement system employing such optical transmission method.

It has hitherto been a normal method in the production process for television receivers or the like to inspect the assembling state using a plurality of measurement devices. For example, when inspecting the assembled state of television receivers by a plurality of measurement devices placed along a belt conveyor, it becomes necessary to transmit information signals between the measurement devices. For such case, it has been customary to perform signal transmission using communication systems such as RS232C or GPIB signal format.

However, such signal transmission makes use of electric cables, and insulation between the measurement devices cannot be achieved, so that there is a risk of circuit destruction due to the difference in the ground potential between the different measurement devices. Besides, connection by electric cables is not desirable because signal transmission by the cable is performed at a site where the noise is likely to be picked up, such as an assembly line.

In addition, it is difficult to raise the information transfer speed with the above enumerated communication systems, so that, if the number of measurement devices connected to the inspection system is increased, it becomes difficult to achieve smooth signal transmission.

The present invention provides a novel measurement device and method employing optical fibre communication. The measurement device necessary for executing the present invention translates the information to be measured into optical signals using a photocoupler and a signal processor having a serial interface enclosed therein, and executes transmission of information signals over an optical fibre cable.

According to the present invention, a plurality of the input/output devices, each including a display device and a signal processing device, are interconnected by an optical fibre cable. The measurement device in the present invention may comprise a television camera, in which case an image processing device may be included in the television camera for providing a more compact system.

The measurement device may be further reduced in size by employing an input/output device in which the display device, the signal processing device and the input keyboard are housed integrally. In such case, the measurement device and the input/output device are interconnected by a fibre cable for light transmission.

The present invention will be further described hereinafter with reference to exemplary embodiments and the accompanying drawings, in which:

Fig.1 is a top plan view showing a general layout of signal transmission by plural measurement devices;

Fig.2 is a schematic block diagram showing a signal processing device shown in Fig.1;

Fig.3 is a perspective view showing a photocoupler

connected to a serial communication link;

Fig.4 is a schematic block diagram showing a modification of the measurement device shown in Fig.1;

Fig.5 is a partial perspective view showing a measurement system employing plural measurement devices;

Fig.6 is a schematic block diagram showing a modification of the measurement device; and

Fig.7 is a schematic block diagram showing another modification of the measurement device.

Referring to the drawings, illustrative embodiments of the present invention will be explained in detail.

The optical signal communication method with the measurement device according to the present invention is employed for transmission of information signals between plural measurement devices. With the communication method according to the present invention, each measurement device includes a photocoupler and a signal processing unit having an interface enclosed therein. The photocouplers of the measurement devices are interconnected by an optical fibre to execute transmission of the information.

The signal communication method by the measurement device according to the present invention is executed by a signal communication device having measurement units shown in Fig.1. That is, a plurality of signal processing units 6a, 6b and 6c and a plurality of photocouplers 5a, 5b, 5c, 5d, 5e and 5f are provided in each of a plurality of measurement units 1, 2 and 3.

Each of the signal processing units 6a, 6b and 6c is a signal processor having a 32-bit central processing unit (CPU)

21, as an example, as shown in Fig.2. Each of the signal processing units 6a, 6b and 6c has a plurality of serial communication links 24 connected to the CPU 21 by a local bus 23.

Each of the signal processing units 6a, 6b and 6c also includes a memory 26 operated under control by the CPU 21, a timer 27 and an external memory interface 25 connected to an external memory, not shown. Thus it is possible for the CPU 21 of each of the signal processing units 6a, 6b and 6c to have communication of information signals with outside over the local bus 23 and the serial communication links 24. Such communication of the information signals is executed by direct memory accessing (DMA) so that transmission of the information at a rate of 20 M bits/ sec is possible by bi-directional communication. As the signal processors 6a, 6b and 6c, a transputer manufactured by SGS Thomson Inc. under the trade name of IMST-805 may be employed.

The photocouplers 5a, 5b, 5c, 5d, 5e and 5f, shown in Fig.3, are connected to each serial communication link 24. Each of the photocouplers 5a, 5b, 5c, 5d, 5e and 5f includes a light emitting section 8 made up of a light emitting diode or a laser diode, and a light receiving section 9 formed by a photodiode or a phototransistor. The light emitting section 8 emits light in a pulsed fashion responsive to digital information signals transmitted from the CPU 21 via the serial communication links 24. The light receiving section 9 receives the light transmitted from outside for translation into digital information signals which are supplied over the serial communication links 24 to the CPU 21.

The light emitting section 8 and the light receiving section 9 are arranged in a socket 10 provided on the front side of a casing member. An optical fibre 4 is coupled via a plug 11 to the socket 10. The photocouplers 5a to 5f execute information transmission, at the above-mentioned rate of 20 M bits /sec, using the non-return to zero (NRZ) code for the transmission signals.

The signal processors 6a, 6b and 6c are connected to measurement sections 7a, 7b and 7c, respectively. A variety of functions may be associated with the measurement sections 7a, 7b and 7c. For example, it is possible for the measurement sections 7a to 7c to measure the length or weight or capture an image and to exchange signals with the signal processors 6a to 6c connected thereto. That is, the measurement sections 7a to 7c are controlled by control signals from the signal processors 6a to 6c and the measured results are transmitted to the signal processors 6a to 6c.

In this manner, the signal processor 6a, photocouplers 5a, 5b and the measurement section 7a make up the measurement unit 1, while the signal processor 6b, photocouplers 5c, 5d and the measurement section 7b make up the measurement unit 2 and the signal processor 6c, photocouplers 5e, 5f and the measurement section 7c make up the measurement unit 3. Although a sole signal processor and a sole measurement section are included in Fig.1 in a measurement unit, there may be occasions where a plurality of signal processors and measurement sections are provided in one measurement unit.

A measurement device 28 employing the above-mentioned measurement units are shown in Figs.4 and 5. That is, the

measurement device 28 includes a control computer 11 and, in an embodiment shown in Fig.4, the measurement units 1 and 2 are connected via the optical fibre 4 to the control computer 11. The control computer 11 includes an input/output device 12 and a contactor 18 connected to the measurement section of the measurement unit. The input/output device 12 includes an indicator and a keyboard, not shown.

A plurality of the measurement devices 28 are incorporated into a production line, as shown in Fig.5. A plurality of the input/output devices 12 are mounted on supporting pillars 29. Each of the input/output devices 12 includes a liquid crystal display device (LCD). A plurality of the contractors 18 are connected to a plurality of objects to be measured 17, while being connected to the measurement devices 28 by flexible cables.

The measurement devices are employed for such a case in which the objects to be measured 17, each placed on a palette transported on a belt conveyor 14, are assembled while measurement operations are performed thereon. Meanwhile, a mechanical section 16 includes an electric motor and a plunger for controlling the palette. The measurement devices are supported on the bottom of the belt conveyor 14 and arrayed along the belt conveyor 14. The measurement devices 28 are interconnected by an optical fibre 31 for signal transmission between the measurement devices 28.

Referring to Fig.4, the measurement device 28 includes a conveyor control section 13 connected to the control computer 11 by the optical fibre 4 for controlling the movement of the belt conveyor 14. Besides, the conveyor control section 13 is

connected to a controller 15 by the optical fibre 4. The controller 15 controls the contactor 18, mechanical section 16 and an adjustment driver controller 19 which controls a screwdriver 20 adapted for adjusting an adjustment screw of the object to be measured 17.

Meanwhile, the serial communication link shown in Fig.2 is enclosed within each of the control computer 11, conveyor control section 13 and the adjustment driver controller 19 for enabling light communication at a rate of 20 M bits/sec.

Fig.6 shows a modification in which the control computer 11 shown in Fig.5 is integrally formed with the input/output device 12. That is, an input/output device 44 includes a control computer 39 therein and an operating key 46 connected to the control computer 39 via a key interface 47. The control computer 39 controls a display controller 49 to cause an image to be displayed on an LCD 45 along with an output of character generator 48.

As explained in connection with Fig.4, a signal processor having a serial interface enclosed therein is included in the control computer 39 for having communication with the outside via the photocoupler 5. A cathode ray tube (CRT) may naturally be employed in place of the LCD 45.

In an embodiment shown in Fig.6, a television camera 40 is employed as a measurement device. The television camera 40 includes an image pickup device 41, an image processing circuit 42 including an A/D converter and a signal processor 43. The signal processor 43 naturally corresponds to the signal processor shown in Fig.2 and includes a serial communication link. Thus the video signals produced by the image pickup unit

41 are translated by the image processing circuit 42 into digital signals which are transmitted from the photocoupler 5 to the control computer 39 of the input/output device 44 via the optical fibre 4.

In the embodiment shown in Fig.6, outputs of plural television cameras 40, 50 are sequentially processed in a pre-set manner by the control computer 39. High-speed image processing may be achieved by providing plural signal processors 65, 66, 67 and 68 in the input/output device 60 as shown in Fig.7 for parallel processing of digital video signals from television cameras 61, 62, 63 and 64. These signal processors 65 to 68 are connected to a control computer 70 for processing the signals in accordance with the control information from the operating key 46. The results of the processing are displayed on a display device 45.

If a plurality of television camera are employed in this manner, the present invention is employed on the production line as shown in Fig.8. That is, a plurality of the television cameras 61, 62 and 63 are arranged along the belt conveyor 14. These television cameras 61 to 63 are arranged for imaging a sole object 67 from different angles. The results of measurement are processed by the input/output device 60 having the image processing unit enclosed therein.

C L A I M S

1. A measurement device comprising a measuring unit, a signal processing unit connected to said measuring unit for processing signals obtained at said measuring unit, said signal processing unit having a serial interface, and a photocoupler connected to said serial interface of said signal processing unit for converting processed signals into the optical information.

2. A measurement device as claimed in claim 1 wherein said photocoupler is coupled to another signal processing unit having a serial interface via an optical fibre cable.

3. A measurement device as claimed in claim 1 wherein said measurement unit includes an imager for imaging an object to be measured.

4. A measurement device as claimed in claim 1 further comprising a control computer coupled to said signal processing unit via said photocoupler via an optical fibre cable, and a display device coupled to said control computer for displaying the results of processing from said control computer.

5. A measurement device as claimed in claim 4 wherein said control computer is housed in an imager housing which further includes a signal processing unit and an image processing circuit for processing image signals taken by said imager.

6. A measurement device as claimed in claim 1 further comprising an input/output device including a display device, a key input device, a photocoupler and a signal processing unit housed within a housing, said input/output device being coupled

to the first mentioned signal processing unit.

7. A measurement device comprising a plurality of imagers each having an imaging device, a signal processing unit having a serial interface and a photocoupler, and a signal processor coupled to each of said imager for processing data transmitted from each of said signal processing units.

8. A measurement device as claimed in claim 7 wherein said signal processing unit in each of said imaging devices executes parallel signal processing to image signals obtained from each of said imaging devices.

9. A method for transmitting measurement data to a signal processor comprising measuring the desired information from an object, converting the desired information thus obtained into serial signals, converting said serial signals into the optical information, and transmitting the optical information to the signal processor by a fibre optical cable.

10. A method for transmitting measurement data to a signal processor as claimed in claim 9, wherein the desired information is the image data of said object and said data has a parallel signal form.

11. A measurement device constructed and arranged to operate substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

Exa ıer's report to the Comptroller under Section 17 (The Search report)	GB 9324593.4
Relevant Technical Fields (i) UK Cl (Ed.M) H4B (BK, BKX, BK8, BK10, BK12, BK24); H4D (DLFB) (ii) Int Cl (Ed.5) G08C 23/00; G01D 5/26; H04B 10/00, 10/10, 10/12, 1/24, 10/08 **Databases** (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii) ONLINE DATABASES: EDOC, WPI	Search Examiner DR E P PLUMMER Date of completion of Search 7 FEBRUARY 1994 Documents considered relevant following a search in respect of Claims :- ALL

Categories of documents

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A: Document indicating technological background and/or state of the art.

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Category	Identity of document and relevant passages		Relevant to claim(s)
X	GB 2228641 A	(MEGGER) eg. Abstract Figure 1	1, 6
X	GB 2196202 A	(PANBOURNE) eg. Abstract, Figure 1	1
X	EP 0272750 A2	(PHILIPS) eg. Abstract, Figure 3	1, 2, 4
X	EP 0266635 A2	(BBC) eg. Figure 1, page 2 line 38 - page 3 line 1	1, 2, 4
X	EP 0263233 A2	(HERAEUS) eg. Figure 3	1
X	EP 0053391 A1	(SIEMENS) eg. Page 13 line 31 - page 14 line 16, page 16 line 10 - page 20 line 19	1, 2, 4, 9
X	EP 0026930 A	(HYDRO-QUEBEC) eg. Abstract, Figure 1	1, 2, 4, 9
X	US 5114227	(LORAL) Whole document	1, 3, 6, 7
X	US 4422180	(MBB) eg. Column 2 lines 3-30, column 5 lines 29-31, column 12 line 68 - column 14 line 41, column 15 line 44 - column 16 line 24, Figure 7, components 72, 81, 82, 84, 86 and 90, Figure 12	1, 2, 4, 6, 9

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).