


JCS11 U.S. PTO 09/175605 10/23/98 Class 348 Subclass 76 ISSUE CLASSIFICATION		PATENT NUMBER 6043839  6043839	
U.S. UTILITY PATENT APPLICATION			
O.I.P.E. SCANNED <i>CK-1</i> <i>OK</i>		PATENT DATE MAR 28 2000	
SECTOR	CLASS 348	SUBCLASS 76	ART UNIT 2713
		EXAMINER Rao	
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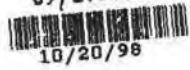
**Issue Fee**

# PATENT APPLICATION



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JCS11 U.S. PTO  
09/175685



10/20/98

INITIALS

OCT 26 98 26

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BER	FILING DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
175,685	10/20/98	348	2713	F97.13-CIP2

WIN L. ADAIR, CASTLE PINES VILLAGE, CO; JEFFREY L. ADAIR,  
 HIGHLANDS RANCH, CO; RANDALL S. ADAIR, DENVER, CO.

\*\*CONTINUING DOMESTIC DATA\*\*\*\*\*  
 VERIFIED THIS APPLN IS A CIP OF 08/944,322 10/06/97

\*\*371 (NAT'L STAGE) DATA\*\*\*\*\*  
 VERIFIED

\*\*FOREIGN APPLICATIONS\*\*\*\*\*  
 VERIFIED

FOREIGN FILING LICENSE GRANTED 10/29/98

\*\*\*\*\* SMALL ENTITY \*\*\*\*\*

Foreign Priority claimed 35 USC 119 (a-d) conditions met	<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> Met after Allowance	STATE OR COUNTRY CO	SHEETS DRAWING 11	TOTAL CLAIMS 7	INDEPENDENT CLAIMS 2
Verified and Acknowledged Examiner's Initials _____ Initials _____					

ADDRESS  
 BRENT P JOHNSON  
 FIELDS & JOHNSON  
 SUITE 5600  
 8480 EAST ORCHARD ROAD  
 ENGLEWOOD CO 80111

TITLE  
 REDUCED AREA IMAGING DEVICES

FILING FEE  
 RECEIVED

\$395

FEES: Authority has been given in Paper  
 No. \_\_\_\_\_ to charge/credit DEPOSIT ACCOUNT  
 NO. \_\_\_\_\_ for the following:

- ☐ 1.15 Fees (Filing)
- ☐ 1.17 Fees (Processing Ext. of time)
- ☐ 1.18 Fees (Issue)
- ☐ Other \_\_\_\_\_
- ☐ Credit \_\_\_\_\_

Samsung Exhibit 1003

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PTO/SB/05 (2/98)  
Approved for use through 09/30/2000. OMB 0651-0032  
Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

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# UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 C.F.R. § 1.53(b))

Attorney Docket No. F97.13 CIP2  
First Inventor or Application Identifier Edwin L. Adair, et al.  
Title Reduced Area Imaging Devices"  
Express Mail Label No. EL146014919US

## APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO: Assistant Commissioner for Patents  
Box Patent Application  
Washington, DC 20231

1. ☒ \* Fee Transmittal Form (e.g., PTO/SB/17)  
(Submit an original and a duplicate for fee processing)
2. ☒ Specification [Total Pages 31]  
(preferred arrangement set forth below)
  - Descriptive title of the invention
  - Cross References to Related Applications
  - Statement Regarding Fed sponsored R & D
  - Reference to Microfiche Appendix
  - Background of the invention
  - Brief Summary of the invention
  - Brief Description of the Drawings (if filed)
  - Detailed Description
  - Claim(s)
  - Abstract of the Disclosure
3. ☒ Drawing(s) (35 U.S.C. 113) [Total Sheets 11]
4. Oath or Declaration [Total Pages 3]
  - a. ☒ Newly executed (original or copy)
  - b. ☐ Copy from a prior application (37 C.F.R. § 1.63(d))  
(for continuation/divisional with Box 17 completed)  
(Note Box 5 below)
  - i. ☐ DELETION OF INVENTOR(S)  
Signed statement attached deleting  
inventor(s) named in the prior application,  
see 37 C.F.R. §§ 1.63(d)(2) and 1.33(b).
5. ☐ Incorporation By Reference (useable if Box 4b is checked)  
The entire disclosure of the prior application, from which a  
copy of the oath or declaration is supplied under Box 4b, is  
considered to be part of the disclosure of the accompanying  
application and is hereby incorporated by reference therein.

6. ☐ Microfiche Computer Program (Appendix)
7. Nucleotide and/or Amino Acid Sequence Submission  
(if applicable, all necessary)
  - a. ☐ Computer Readable Copy
  - b. ☐ Paper Copy (identical to computer copy)
  - c. ☐ Statement verifying identity of above copies

## ACCOMPANYING APPLICATION PARTS

8. ☐ Assignment Papers (cover sheet & document(s))
9. ☐ 37 C.F.R. § 3.73(b) Statement  
(when there is an assignee) ☒ Power of Attorney
10. ☐ English Translation Document (if applicable)
11. ☐ Information Disclosure Statement (IDS)/PTO-1449 ☐ Copies of IDS Citations
12. ☐ Preliminary Amendment
13. ☒ Return Receipt Postcard (MPEP 503)  
(Should be specifically itemized)
14. ☒ \* Small Entity Statement(s) ☐ Statement filed in prior application,  
(PTO/SB/09-12) Status still proper and desired
15. ☐ Certified Copy of Priority Document(s)  
(if foreign priority is claimed)
16. ☐ Other: Declaration Under 37 CFR 1.102  
Petition to Make Special (1.102)

\* NOTE FOR ITEMS 1 & 14: IN ORDER TO BE ENTITLED TO PAY SMALL ENTITY  
FEES, A SMALL ENTITY STATEMENT IS REQUIRED (37 C.F.R. § 1.27), EXCEPT  
IF ONE FILED IN A PRIOR APPLICATION IS RELIED UPON (37 C.F.R. § 1.28).

17. If a CONTINUING APPLICATION, check appropriate box, and supply the requisite information below and in a preliminary amendment:

☐ Continuation ☐ Divisional ☒ Continuation-in-part (CIP) of prior application No: 08 1,944,322  
Prior application Information: Examiner A. Rao Group / Art Unit: 2713

## 18. CORRESPONDENCE ADDRESS

☐ Customer Number or Bar Code Label (Insert Customer No. or Attach bar code label here) or ☒ Correspondence address below

Name	<u>Brent P. Johnson</u>				
	<u>Fields &amp; Johnson, P.C.</u>				
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Country	<u>U.S.A.</u>	Telephone	<u>303-689-9100</u>	Fax	<u>303-689-9250</u>

Name (Print/Type)	<u>Brent P. Johnson</u>	Registration No. (Attorney/Agent)	<u>38,031</u>
Signature	<u>[Signature]</u>	Date	<u>10/20/98</u>

Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Box Patent Application, Washington, DC 20231.



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**FEE TRANSMITTAL**

Patent fees are subject to annual revision on October 1.

These are the fees effective October 1, 1997.

Small Entity payments must be supported by a small entity statement,  
otherwise large entity fees must be paid. See Forms PTO/SB/09-12.  
See 37 C.F.R. §§ 1.27 and 1.28.

TOTAL AMOUNT OF PAYMENT (\$) 395.00

**Complete if Known**

Application Number	
Filing Date	
First Named Inventor	Edwin L. Adair, et al.
Examiner Name	
Group / Art Unit	
Attorney Docket No.	F97.13 CIP2

**METHOD OF PAYMENT (check one)**

- 1.
- ☒
- The Commissioner is hereby authorized to charge indicated fees and credit any over payments to:

Deposit Account Number	06-0778
Deposit Account Name	Fields & Johnson, P.C.

☒ Charge Any Additional Fee Required Under 37 C.F.R. §§ 1.16 and 1.17 ☐ Charge the Issue Fee Set in 37 C.F.R. § 1.16 at the Mailing of the Notice of Allowance

- 2.
- ☒
- Payment Enclosed:
- 
- ☒
- Check
- ☐
- Money Order
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- Other

**FEE CALCULATION****1. BASIC FILING FEE**

Large Entity Fee Code (\$)	Small Entity Fee Code (\$)	Fee Description	Fee Paid
101 790	201 395	Utility filing fee	395
106 330	206 165	Design filing fee	
107 540	207 270	Plant filing fee	
108 790	208 395	Reissue filing fee	
114 150	214 75	Provisional filing fee	
<b>SUBTOTAL (1)</b>			<b>(\$)</b> 395

**2. EXTRA CLAIM FEES**

Total Claims	Extra Claims	Fee from below	Fee Paid
Independent Claims	7 - 20** = 0	X 11 = 0	
Multiple Dependent Claims	2 - 3** = 0	X 41 = 0	

\*\*or number previously paid, if greater; For Reissues, see below

Large Entity Fee Code (\$)	Small Entity Fee Code (\$)	Fee Description
103 22	203 11	Claims in excess of 20
102 82	202 41	Independent claims in excess of 3
104 270	204 135	Multiple dependent claim, if not paid
109 82	209 41	** Reissue independent claims over original patent
110 22	210 11	** Reissue claims in excess of 20 and over original patent

**SUBTOTAL (2)** (\$) 0**FEE CALCULATION (continued)****3. ADDITIONAL FEES**

Large Entity Fee Code (\$)	Small Entity Fee Code (\$)	Fee Description	Fee Paid
105 130	205 65	Surcharge - late filing fee or oath	
127 50	227 25	Surcharge - late provisional filing fee or cover sheet	
139 130	139 130	Non-English specification	
147 2,520	147 2,520	For filing a request for reexamination	
112 920*	112 920*	Requesting publication of SIR prior to Examiner action	
113 1,840*	113 1,840*	Requesting publication of SIR after Examiner action	
115 110	215 55	Extension for reply within first month	
116 400	216 200	Extension for reply within second month	
117 950	217 475	Extension for reply within third month	
118 1,510	218 755	Extension for reply within fourth month	
128 2,080	228 1,030	Extension for reply within fifth month	
119 310	219 155	Notice of Appeal	
120 310	220 155	Filing a brief in support of an appeal	
121 270	221 135	Request for oral hearing	
138 1,510	138 1,510	Petition to institute a public use proceeding	
140 110	240 55	Petition to revive - unavoidable	
141 1,320	241 660	Petition to revive - unintentional	
142 1,320	242 660	Utility issue fee (or reissue)	
143 450	243 225	Design issue fee	
144 670	244 335	Plant issue fee	
122 130	122 130	Petitions to the Commissioner	
123 50	123 50	Petitions related to provisional applications	
126 240	126 240	Submission of Information Disclosure Stmt	
581 40	581 40	Recording each patent assignment per property (times number of properties)	
146 790	246 395	Filing a submission after final rejection (37 CFR 1.129(a))	
149 790	249 395	For each additional invention to be examined (37 CFR 1.129(b))	

Other fee (specify) \_\_\_\_\_

Other fee (specify) \_\_\_\_\_

\* Reduced by Basic Filing Fee Paid

**SUBTOTAL (3)** (\$) 0**SUBMITTED BY**

Typed or Printed Name Brent P. Johnson

Signature

Date

10/20/98

**Complete (if applicable)**

Reg. Number 38,031

Deposit Account User ID

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10/20/98  
1512 U.S. PTO

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re the Continuation-in-Part Application of )  
)  
Edwin L. Adair, Jeffrey L. Adair, )  
Randall S. Adair )  
)  
Corresponding to )  
U.S. Serial No. 08/944,322 )  
Filed: October 6, 1997 )  
)  
For: "Reduced Area Imaging Devices" )

"Express Mail" mailing label number EL146014919US

Date of Deposit: October 20, 1997

I hereby certify that the following:

- Patent application
- 11 sheets of formal drawings
- Declaration and Power of Attorney
- Declaration Under 37 CFR 1.102
- Petition to Make Special Under 37 CFR 1.102
- Verified Statement for Small Entity
- Patent Application Transmittal form
- 1 original and 1 copy of Fee Transmittal form and Fee Determination Record form
- Check for \$ 395.00 for the filing fees
- Return postcard

are being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and are addressed to the BOX PATENT APPLICATION, Assistant Commissioner for Patents, Washington, D.C. 20231 .

Katherine L. Goncalves  
Katherine L. Goncalves  
8480 East Orchard Road, Suite 5600  
Englewood, CO 80111  
(303) 689-9100

Date: 10/20/98



**REDUCED AREA IMAGING DEVICES**

This application is a continuation-in-part of U.S. Serial No. 08/944,322, filed October 6, 1997, and entitled "Reduced Area Imaging Devices Incorporated Within Surgical Instruments."

**5    Technical Field**

This invention relates to solid state image sensors and associated electronics, and more particularly, to solid state image sensors which are configured to be of a minimum size.

**Background Art**

10            In recent years, endoscopic surgery has become the accepted standard for conducting many types of surgical procedures, both in the medical and dental arenas. The availability of imaging devices enabling a surgeon or dentist to view a particular surgical area through a small diameter endoscope which is introduced into small cavities or openings in  
15            the body results in much less patient trauma as well as many other advantages.

             In many hospitals, the rod lens endoscope is still used in endoscopic surgery. The rod lens endoscope includes a very precise group of lenses in an elongate and rigid tube which are able to accurately transmit an image to  
20            a remote camera in line with the lens group. The rod lens endoscope, because of its cost of manufacture, failure rate, and requirement to be housed within a rigid and straight housing, is being increasingly replaced by solid state imaging technology which enables the image sensor to be placed at the distal tip of the investigating device. The three most common  
25            solid state image sensors include charged coupled devices (CCD), charge injection devices (CID) and photo diode arrays (PDA). In the mid-1980s,

complementary metal oxide semiconductors (CMOS) were developed for industrial use. CMOS imaging devices offer improved functionality and simplified system interfacing. Furthermore, many CMOS imagers can be manufactured at a fraction of the cost of other solid state imaging technologies.

One particular advance in CMOS technology has been in the active pixel-type CMOS imagers which consist of randomly accessible pixels with an amplifier at each pixel site. One advantage of active pixel-type imagers is that the amplifier placement results in lower noise levels than CCDs or other solid state imagers. Another major advantage is that these CMOS imagers can be mass produced on standard semiconductor production lines. One particularly notable advance in the area of CMOS imagers including active pixel-type arrays is the CMOS imager described in U.S. Patent No. 5,471,515 to Fossum, et al. This CMOS imager can incorporate a number of other different electronic controls that are usually found on multiple circuit boards of much larger size. For example, timing circuits, and special functions such as zoom and anti-jitter controls can be placed on the same circuit board containing the CMOS pixel array without significantly increasing the overall size of the host circuit board. Furthermore, this particular CMOS imager requires 100 times less power than a CCD-type imager. In short, the CMOS imager disclosed in Fossum, et al. has enabled the development of a "camera on a chip."

Passive pixel-type CMOS imagers have also been improved so that they too can be used in an imaging device which qualifies as a "camera on a chip." In short, the major difference between passive and active CMOS pixel arrays is that a passive pixel-type imager does not perform signal amplification at each pixel site. One example of a manufacturer which has



developed a passive pixel array with performance nearly equal to known active pixel devices and being compatible with the read out circuitry disclosed in the U.S. Patent No. 5,471,515 is VLSI Vision, Ltd., 1190 Saratoga Avenue, Suite 180, San Jose, California 95129. A further  
5 description of this passive pixel device may be found in co-pending application, Serial No. 08/976,976, entitled "Reduced Area Imaging Devices Incorporated Within Surgical Instruments," and is hereby incorporated by reference.

In addition to the active pixel-type CMOS imager which is disclosed  
10 in U.S. Patent No. 5,471,515, there have been developments in the industry for other solid state imagers which have resulted in the ability to have a "camera on a chip." For example, Suni Microsystems, Inc. of Mountain View, California, has developed a CCD/CMOS hybrid which combines the high quality image processing of CCDs with standard CMOS circuitry  
15 construction. In short, Suni Microsystems, Inc. has modified the standard CMOS and CCD manufacturing processes to create a hybrid process providing CCD components with their own substrate which is separate from the P well and N well substrates used by the CMOS components. Accordingly, the CCD and CMOS components of the hybrid may reside on  
20 different regions of the same chip or wafer. Additionally, this hybrid is able to run on a low power source (5 volts) which is normally not possible on standard CCD imagers which require 10 to 30 volt power supplies. A brief explanation of this CCD/CMOS hybrid can be found in the article entitled "Startup Suni Bets on Integrated Process" found in *Electronic*  
25 *News*, January 20, 1997 issue. This reference is hereby incorporated by reference for purposes of explaining this particular type of imaging processor.

Another example of a recent development in solid state imaging is the development of CMOS imaging sensor which is able to achieve analog to digital conversion on each of the pixels within the pixel array. This type of improved CMOS imager includes transistors at every pixel to provide digital instead of analog output that enable the delivery of decoders and sense amplifiers much like standard memory chips. With this new technology, it may, therefore, be possible to manufacture a true digital "camera on a chip." This CMOS imager has been developed by a Stanford University joint project and is headed by Professor Abbas el-Gamal.

A second approach to creating a CMOS-based digital imaging device includes the use of an over-sample converter at each pixel with a one bit comparator placed at the edge of the pixel array instead of performing all of the analog to digital functions on the pixel. This new design technology has been called MOSAD (multiplexed over sample analog to digital) conversion. The result of this new process is low power usage, along with the capability to achieve enhanced dynamic range, possibly up to 20 bits. This process has been developed by Amain Electronics of Simi Valley, California. A brief description of both of the processes developed by Stanford University and Amain Electronics can be found in an article entitled "A/D Conversion Revolution for CMOS Sensor?," September 1998 issue of *Advanced Imaging*. This reference is also hereby incorporated by reference for purposes of explaining these particular types of imaging processors.

The above-mentioned developments in solid state imaging technology have shown that "camera on a chip" devices will continue to be enhanced not only in terms of the quality of imaging which may be



achieved, but also in the specific construction of the devices which may be manufactured by new breakthrough processes.

Although the "camera on a chip" concept is one which has great merit for application in many industrial areas, a need still exists for a  
5 reduced area imaging device which can be used in even the smallest type of endoscopic instruments in order to view areas in the body that are particularly difficult to access, and to further minimize patient trauma by an even smaller diameter invasive instrument.

It is one object of this invention to provide reduced area imaging  
10 devices which take advantage of "camera on a chip" technology, but rearrange the circuitry in a stacked relationship so that there is a minimum profile presented when used within a surgical instrument or other investigative device. It is another object of this invention to provide low cost imaging devices which may be "disposable." It is yet another object  
15 of this invention to provide reduced area imaging devices which may be used in conjunction with standard endoscopes by placing the imaging device through channels which normally receive other surgical devices, or receive liquids or gases for flushing a surgical area. It is yet another object of this invention to provide a surgical device with imaging capability which  
20 may be battery powered and only requires one conductor for transmitting a pre-video signal to video processing circuitry within or outside the sterile field of the surgical area.

In addition to the intended use of the foregoing invention with respect to surgical procedures conducted by medical doctors, it is also  
25 contemplated that the invention described herein has great utility with respect to oral surgery and general dental procedures wherein a very small imaging device can be used to provide an image of particularly difficult to

access locations. Additionally, while the foregoing invention has application with respect to the medical and dental fields, it will also be appreciated by those skilled in the art that the small size of the imaging device set forth herein can be applied to other functional disciplines wherein the imaging device can be used to view difficult to access locations for industrial equipment and the like. Therefore, the imaging device of this invention could be used to replace many industrial boroscopes.

The "camera on a chip" technology can be further improved with respect to reducing its profile area and incorporating such a reduced area imaging device into very small investigative instruments which can be used in the medical, dental, or other industrial fields.

#### **Disclosure of the Invention**

In accordance with the present invention, reduced area imaging devices are provided. The term "imaging device" as used herein describes the imaging elements and processing circuitry which is used to produce a video signal which may be accepted by a standard video device such as a television or video monitor accompanying a personal computer. The term "image sensor" as used herein describes the components of a solid state imaging device which captures images and stores them within the structure of each of the pixels in the array of pixels found in the imaging device. As further discussed below, the timing and control circuits can be placed either on the same planar structure as the pixel array, in which case the image sensor can also be defined as an integrated circuit, or the timing and control circuitry can be placed remote from the pixel array. The terms "signal" or "image signal" as used herein, and unless otherwise more specifically

defined, refer to an image which at some point during its processing by the imaging device, is found in the form of electrons which have been placed in a specific format or domain. The term "processing circuitry" as used herein refers to the electronic components within the imaging device which receive the image signal from the image sensor and ultimately place the image signal in a usable format. The terms "timing and control circuits" or "circuitry" as used herein refer to the electronic components which control the release of the image signal from the pixel array.

In a first embodiment, the image sensor, with or without the timing and control circuitry, may be placed at the distal tip of the endoscopic instrument while the remaining processing circuitry may be found in a small remote control box which may communicate with the image sensor by a single cable.

In a second embodiment, the image sensor and the processing circuitry may all be placed in a stacked arrangement of circuit boards and positioned at the distal tip of the endoscopic instrument. In this embodiment, the pixel array of the image sensor may be placed by itself on its own circuit board while the timing and control circuitry and processing circuitry are placed on one or more other circuit boards. Alternatively, the circuitry for timing and control may be placed with the pixel array on one circuit board, while the remaining processing circuitry can be placed on one or more of the other circuit boards.

In yet another embodiment, the imaging device may be adapted for use with a standard rod lens endoscope wherein the imaging device is placed within a standard camera housing which is configured to connect to a standard "C" or "V" mount connector.



A generic endoscope may be used in the first and second embodiments which includes a very small diameter tubular portion which is inserted within the patient. The tubular portion may be made of a flexible material having a central lumen or opening therein for receiving the elements of the imaging device. The tubular portion may be modified to include an additional concentric tube placed within the central lumen and which enables a plurality of light fibers to be placed circumferentially around the periphery of the distal end of the tubular portion. Additionally, control wires may extend along the tubular portion in order to make the endoscope steerable. The material used to make the endoscope can be compatible with any desired sterilization protocol, or the entire endoscope can be made sterile and disposable after use.

For the configuration of the imaging device which calls for the array of pixels and the timing and control circuitry to be placed on the same circuit board, only one conductor is required in order to transmit the image signal to the processing circuitry. In the other configuration of the imaging device wherein the timing and control circuits are incorporated onto other circuit boards, a plurality of connections are required in order to connect the timing and control circuitry to the pixel array and the one conductor is also required to transmit the image signal.

### **Brief Description of the Drawings**

Figure 1a illustrates a first embodiment including a fragmentary cross-sectional view of a generic endoscopic instrument, and a fragmentary perspective view of a control box, the endoscope and control box each incorporating elements of a reduced area imaging device;

Figure 1b is an enlarged fragmentary partially exploded perspective view of the distal end of the endoscopic instrument specifically illustrating the arrangement of the image sensor with respect to the other elements of the tubular portion of the endoscope;

5        Figure 2a is a fragmentary cross-sectional view of a second embodiment of this invention illustrating another generic endoscope wherein the imaging device is incorporated in its entirety at the distal tip of the endoscope;

10        Figure 2b is an enlarged fragmentary partially exploded perspective view of the distal end of the endoscope of Figure 2a illustrating the imaging device;

Figure 3a is an elevational fragmentary cross-sectional view of the image sensor incorporated with a standard camera housing for connection to a rod lens endoscope;

15        Figure 3b is a fragmentary cross-sectional view of the imaging device incorporated within the camera housing of Figure 3a;

Figure 3c is a fragmentary cross-sectional view similar to that of Figure 3b illustrating a battery as an alternate source of power;

20        Figure 4 is a schematic diagram of the functional electronic components which make up the imaging device;

Figure 4a is an enlarged schematic diagram of a circuit board which may include the array of pixels and the timing and control circuitry;

25        Figure 4b is an enlarged schematic diagram of a video processing board having placed thereon the processing circuitry which processes the pre-video signal generated by the array of pixels and which converts the pre-video signal to a post-video signal which may be accepted by a standard video device; and

Figures 5a-5e are schematic diagrams that illustrate an example of specific circuitry which may be used to make the imaging device.

### **Best Mode for Carrying Out the Invention**

- In accordance with one embodiment of the invention as shown in Figure 1a, an endoscope 10 is provided which incorporates a reduced area imaging device 11, shown in Figure 1b. As further discussed below, the elements of the imaging device may all be found at one location or the elements may be separated from one another and interconnected by the appropriate cable(s). The array of pixels making up the image sensor captures images and stores them in the form of electrical energy by conversion of light photons to electrons. This conversion takes place by the photo diodes in each pixel which communicate with one or more capacitors which store the electrons. The structure of the endoscope 10, includes a flexible or rigid tubular portion 14 which is inserted into the body of the patient and is placed at the appropriate location for viewing a desired surgical area. The tubular portion 14 attaches at its proximal end to a handle portion 12 which may be grasped by a surgeon who is conducting the endoscopic procedure. The handle 12 may include a central lumen or channel 13 which receives therethrough one or more cables or other structures which extend to the distal end 16 of tubular portion 14. Handle portion 12 may further include a supplementary channel 15 which intersects with central channel 13 and which may provide another point of entry for other cables, fluids or operative instruments to be placed through the endoscope.
- Figure 1b illustrates the distal end of the endoscope 16. The distal end 16 may be characterized by an outer tube 18 which traverses the length

of the tubular portion 14 and connects to the handle portion 12. Placed concentrically within the outer tube 18 may be one or more inner tubes 20. In Figure 1b, the gap between inner tube 20 and outer tube 18 forms a space in which one or more light fibers 22 or control wires 24 may be placed. As well understood by those skilled in the art, a plurality of circumferentially spaced light fibers as illustrated in Figure 1b can be used to illuminate the surgical site. Additionally, the control wires 24 may communicate with a control mechanism (not shown) integrated on the handle portion 12 for manipulating the distal end 16 of the endoscope in a desired direction. The flexible tubular portion 14 coupled with a steerable feature enables the endoscope to be placed within winding bodily passages or other locations difficult to reach within the body.

An image sensor 40 may be placed within the central channel defined by inner tube 20. In the configuration shown in Figure 1b, a cable 26 is used to house the conductors which communicate with the image sensor 40. An intermediate support tube 28 may be placed concentrically outside of cable 26 and concentrically within inner tube 20 to provide the necessary support for the cable 26 as it traverses through the inner channel defined by inner tube 20. In lieu of support tube 28, other well-known means may be provided to stabilize the cable 26 such as clips or other fastening means which may attach to the inner concentric surface of inner tube 20.

A control box 30 may be placed remote from the endoscope 10. The control box 30 contains some of the processing circuitry which is used to process the image signal produced by image sensor 40. Therefore, the imaging device 11 as previously defined would include the processing circuitry within control box 30 and the image sensor 40 located at the distal



tip of the endoscope. Control box 30 communicates with image sensor 40 by means of cable 32 which may simply be an insulated and shielded cable which houses therein cable 26. Cable 32 is stabilized with respect to the handle portion 12 by means of a fitting 34 which ensures that cable 32 cannot be inadvertently pushed or pulled within channel 13. Additionally, an additional fitting 35 may be provided to stabilize the entry of a light cable 36 which houses the plurality of light fibers 22.

Image sensor 40 is illustrated as being a planar and square shaped member. However, the image sensor may be modified to be in a planar and circular shape to better fit within the channel defined by inner tube 20. Accordingly, Figure 1b further shows an alternate shaped image sensor 40' which is round. A lens group or system 42 may be incorporated at the distal end of the endoscope in order to manipulate the image prior to it being impinged upon the array of pixels on the image sensor 40. This lens system 42 may be sealed at the distal end 16 of the endoscope so that the tubular portion 14 is impervious to fluids entering through the distal end 16. In the configuration of the imaging device 11 in Figures 1a and 1b, there are only three conductors which are necessary for providing power to the image sensor 40, and for transmitting an image from the image sensor 40 back to the processing circuitry found within control box 30. Namely, there is a power conductor 44, a grounding conductor 46, and an image signal conductor 48 each of which are hard wired to the image sensor. Thus, cable 26 may simply be a three-conductor 50 ohm cable.

Image sensor 40 can be as small as 1 mm in its largest dimension. However, a more preferable size for most endoscopic procedures would dictate that the image sensor 40 be between 4 mm to 8 mm in its largest dimension. The image signal transmitted from the image sensor through

conductor 48 is also herein referred to as a pre-video signal. Once the pre-video signal has been transmitted from image sensor 40 by means of conductor 48, it is received by video processing board 50. Video processing board 50 then carries out all the necessary conditioning of the pre-video signal and places it in a form so that it may be viewed directly on a standard video device, television or standard computer video monitor.

The signal produced by the video processing board 50 can be further defined as a post-video signal which can be accepted by a standard video device. As shown in Figure 1a, a conductor 49 is provided which transmits

the post-video signal to an output connector 58 on the exterior surface of control box 30. The cable (not shown) extending from the desired video device (not shown) may receive the post-video signal by means of connector 58. Power supply board 52 may convert incoming power

received through power source 54 into the desired voltage. In the preferred imager incorporated in this invention, the power to the imaging device is simply a direct current which can be a 1.5 volt to a 12 volt source.

Incoming power from, for example, a wall receptacle, communicates with power supply board 52 by connector 56. Power supply board 52 takes the incoming power source and regulates it to the desired level. Additionally, ground 46 is also shown as extending back to the source of power through connector 56.

Figure 2a illustrates a second embodiment of this invention wherein the imaging device is self-contained entirely within the distal end 16 of the endoscope, and a power source which drives the circuitry within the imaging device may come from a battery 66 housed within handle portion 12.

As shown in Figure 2b, the video processing board 50 may be placed directly behind image sensor 40. A plurality of pin connectors 62 serve to electrically couple image sensor 40 with video processing board 50 depending upon the specific configuration of image sensor 40, pin connectors 62 may be provided either for structural support only, or to provide a means by which image signals are transmitted between image sensor 40 and board 50. When necessary, one or more supplementary boards 60 may be provided which further contain processing circuitry to process the image signal and present it in a form which may be directly received by a desired video device. The area which is occupied by image sensor 40 may be defined as the profile area of the imaging device and which determines its critical dimensions. Any imaging elements that are found on boards 50 or 60 must be able to be placed on one or more circuit boards which are longitudinally aligned with image sensor 40 along longitudinal axis XX. If the profile area is not critical in terms of limiting the largest sized imaging element within the imaging device, then the additional circuit boards 50 and 60 which are normally placed in line with image sensor 40 can be aligned in an offset manner or may be larger than the profile area of image sensor 40. In the configuration of Figure 2b, it is desirable that elements 40, 50 and 60 be approximately the same size so that they may fit uniformly within the central channel of the endoscope. Additionally, image sensor 40 may be bonded to lens system 42 in order to provide further structural support to the imaging device 11 when mounted within the distal end 16.

Referring back to the handle portion 12 in Figure 2a, an additional channel 64 may be provided in order that a power supply cable 68 may communicate with battery 66. Conveniently, battery 66 may itself be

mounted within a well 65 formed in handle portion 12. Cable 68 carries the conductor 44 and ground 46. Cable 68 may intersect with cable 33 within channel 13, cables 68 and 33 extending then to the distal end 16. Cable 33 can be a single conductor cable which transmits the post-video signal to a desired video device. In other words, cable 33 may simply be an insulated and shielded housing for conductor 49 which carries the post-video signal. Because a preferred image sensor of the imaging device 11 may only require a 5 volt power supply, a battery is an ideal power source in lieu of a conductor which would trail the endoscope. Accordingly, the endoscope is made more mobile and easier to handle by eliminating at least one of the trailing cables.

Figure 3a illustrates yet another preferred embodiment of this invention, wherein the imaging device can be used in conjunction with a standard rod lens endoscope 70. As shown, rod lens endoscope 70 includes a lens train 72 which includes a plurality of highly precise lenses (not shown) which are able to transmit an image from the distal end of the endoscope, to a camera in line with the endoscope. The rod lens endoscope is equipped with a light guide coupling post 74. Light guide post 74 connects to a source of light in the form of a cable 77 having a plurality of fiber optic strands (not shown) which communicate with a source of light (not shown). The most common arrangement of the rod lens endoscope also includes a "C" or "V" mount connector 78 which attaches to the eyepiece 76. The "C" or "V" mount attaches at its other end to a camera group 80. The camera group 80 houses one or more of the elements of the imaging device. In this embodiment, the small size of the imaging device is not a critical concern since the imaging device is not being placed at the distal end of the endoscope. However, the incorporation of the imaging



device in a housing which would normally hold a traditional camera still provides an advantageous arrangement. As shown, the camera group 80 may include a housing 82 which connects to a power/video cable 86.

Fitting 87 is provided to couple cable 86 to the interior elements of the

5 camera group 80 found within housing 82. Figure 3a illustrates an arrangement of the imaging device 11 wherein the image sensor 40 is placed by itself within the housing 82 and the processing circuitry of the imaging device can be positioned in a remote control box as shown in Figure 1a. Accordingly, only three conductors 44, 46 and 48 are necessary  
10 for providing power to the image sensor 40 and for transmitting the pre-video signal to the control box. Alternatively, as shown in Figure 3b, the entire imaging device 11 may be incorporated within camera group 80, **each of the elements of the imaging device being placed in the stacked arrangement similar to Figure 2b.** As discussed above, size is not as much  
15 of a concern in the embodiment of Figure 3a and 3b since the camera group housing 82 is much larger than the distal tip of the endoscope of Figures 1a and 2a.

Figure 3c also illustrates the use of a battery 66 which provides source of power to the imaging device in either Figure 3a or 3b . In this  
20 arrangement, housing 82 is altered to include a battery housing 69 which houses the battery 66 therein. Battery housing 69 may include a very small diameter channel which may allow conductor 48 or 49 to communicate directly with the processing circuitry or video device, respectively. It will also be understood that the embodiment in Figure 1a may incorporate the  
25 use of a battery 66 as the source of power. Thus, handle 12 in Figure 1a may be altered in the same way as housing 82 to allow a battery to be attached to the handle portion 12.

Figure 4 is a schematic diagram illustrating one way in which the imaging device 11 may be constructed. As illustrated, the image sensor 40 may include the timing and control circuits on the same planar structure. Power is supplied to image sensor 40 by power supply board 52. The connection between image sensor 40 and board 52 may simply be a cable having two conductors therein, one for ground and another for transmitting the desired voltage. These are illustrated as conductors 44 and 46. The output from image sensor 40 in the form of the pre-video signal is input to video processor board 50 by means of the conductor 48. In the configuration of Figure 4, conductor 48 may simply be a 50 ohm conductor. Power and ground also are supplied to video processing board 50 by conductors 44 and 46 from power supply board 52. The output signal from the video processor board 50 is in the form of the post-video signal and which may be carried by conductor 49 which can also be a 50 ohm conductor.

In the first embodiment illustrated in Figure 1a, cable 32 can be used to house conductors 44, 46 and 48. In the embodiment shown in Figure 2a, cable 33 can be used to house conductor 49 by itself when a battery power source is used, or alternatively, cable 33 may house conductors 44, 46 and 49 if the embodiment of Figure 2a utilizes a power source from board 52.

Optionally, a supplementary processing board 60 may be provided to further enhance the pre-video signal. As shown in Figure 4, the supplementary board 60 may be placed such that the pre-video signal from image sensor 40 is first sent to the supplementary board and then output to the video processor board 50. In this case, the output from board 50 can be carried along conductor 51. This output can be defined as an enhanced pre-video signal. Furthermore, the post-video signal from video processor

board 50 may return to the supplementary board 60 for further processing, as further discussed below. The conductor used to transmit the post-video signal back to the supplementary board is shown as conductor 59. The power supply board 52 may also provide power to the supplementary board in the same manner as to image sensor 40 and board 50. That is, a simple hard-wired connection is made onto the supplementary board for the ground and voltage carrying conductors. As discussed above, image sensor 40 may be placed remotely from boards 50 and 60. Alternatively, image sensor 40, and boards 50 and 60 each may be placed within the distal end of the endoscope.

Although Figure 4 illustrates the image sensor and the timing and control circuits being placed on the same planar structure, it is possible to separate the timing and control circuits from the pixel array and place the timing and control circuits onto video processing board 50. The advantage in placing the timing and control circuits on the same planar structure as the image sensor is that only three connections are required between image sensor 40 and the rest of the imaging device, namely, conductors 44, 46 and 48. Additionally, placing the timing and control circuits on the same planar structure with the pixel array results in the pre-video signal having less noise. Furthermore, the addition of the timing and control circuits to the same planar structure carrying the image sensor only adds a negligible amount of size to one dimension of the planar structure. If the pixel array is to be the only element on the planar structure, then additional connections must be made between the planar structure and the video processing board 50 in order to transmit the clock signals and other control signals to the pixel array. For example, a ribbon-type cable (not shown) or a plurality of 50 ohm coaxial cables (not shown) must be used in order to

control the downloading of information from the pixel array. Each of these additional connections would be hard wired between the boards.

Figure 4a is a more detailed schematic diagram of image sensor 40 which contains an array of pixels 90 and the timing and control circuits 92.

5 One example of a pixel array 90 which can be used within the invention is similar to that which is disclosed in U.S. Patent No. 5,471,515 to Fossum, et al., said patent being incorporated by reference herein. More specifically, Figure 3 of Fossum, et al. illustrates the circuitry which makes up each pixel in the array of pixels 90. The array of pixels 90 as described  
10 in Fossum, et al. is an active pixel group with intra-pixel charged transfer. The image sensor made by the array of pixels is formed as a monolithic complementary metal oxide semiconductor integrated circuit which may be manufactured in an industry standard complementary metal oxide semiconductor process. The integrated circuit includes a focal plane array  
15 of pixel cells, each one of the cells including a photo gate overlying the substrate for accumulating the photo generated charges. In broader terms, as well understood by those skilled in the art, an image impinges upon the array of pixels, the image being in the form of photons which strike the photo diodes in the array of pixels. The photo diodes or photo detectors  
20 convert the photons into electrical energy or electrons which are stored in capacitors found in each pixel circuit. Each pixel circuit has its own amplifier which is controlled by the timing and control circuitry discussed below. The information or electrons stored in the capacitors is unloaded in the desired sequence and at a desired frequency, and then sent to the video  
25 processing board 50 for further processing.

Although the active pixel array disclosed in U.S. Patent No. 5,471,515 is mentioned herein, it will be understood that the hybrid



CCD/CMOS described above, or any other solid state imaging device may be used wherein timing and control circuits can be placed either on the same planar structure with the pixel array, or may be separated and placed remotely. Furthermore, it will be clearly understood that the invention  
5 claimed herein is not specifically limited to an image sensor as disclosed in the U.S. Patent No. 5,471,515, but encompasses any image sensor which may be configured for use in conjunction with the other processing circuitry which makes up the imaging device of this invention.

The timing and control circuits 92 are used to control the release of  
10 the image information or image signal stored in the pixel array. In the image sensor of Fossum, et al., the pixels are arranged in a plurality of rows and columns. The image information from each of the pixels is first consolidated in a row by row fashion, and is then downloaded from one or more columns which contain the consolidated information from the rows.  
15 As shown in Figure 4a, the control of information consolidated from the rows is achieved by latches 94, counter 96, and decoder 98. The operation of the latches, counter and decoder is similar to the operation of similar control circuitry found in other imaging devices. That is, a latch is a means of controlling the flow of electrons from each individual addressed pixel in  
20 the array of pixels. When a latch 94 is enabled, it will allow the transfer of electrons to the decoder 98. The counter 96 is programmed to count a discrete amount of information based upon a clock input from the timing and control circuits 92. When the counter 96 has reached its set point or overflows, the image information is allowed to pass through the latches 94  
25 and be sent to the decoder 98 which places the consolidated information in a serial format. Once the decoder 98 has decoded the information and placed it in the serial format, then the row driver 100 accounts for the serial

information from each row and enables each row to be downloaded by the column or columns. In short, the latches 94 will initially allow the information stored in each pixel to be accessed. The counter 96 then controls the amount of information flow based upon a desired time sequence. Once the counter has reached its set point, the decoder 98 then knows to take the information and place it in the serial format. The whole process is repeated, based upon the timing sequence that is programmed. When the row driver 100 has accounted for each of the rows, the row driver reads out each of the rows at the desired video rate.

The information released from the column or columns is also controlled by a series of latches 102, a counter 104 and a decoder 106. As with the information from the rows, the column information is also placed in a serial format which may then be sent to the video processing board 50. This serial format of column information is the pre-video signal carried by conductor 48. The column signal conditioner 108 places the column serial information in a manageable format in the form of desired voltage levels. In other words, the column signal conditioner 108 only accepts desired voltages from the downloaded column(s).

The clock input to the timing and control circuits 92 may simply be a quartz crystal timer. This clock input is divided into many other frequencies for use by the various counters. The run input to the timing and control circuit 92 may simply be an on/off control. The default input can allow one to input the pre-video signal to a video processor board which may run at a frequency of other than 30 hertz. The data input controls functions such as zoom. At least for a CMOS type active pixel array which can be accessed in a random manner, features such as zoom

are easily manipulated by addressing only those pixels which locate a desired area of interest by the surgeon.

A further discussion of the timing and control circuitry which may be used in conjunction with an active pixel array is disclosed in U.S. Patent  
5 No. 5,471,515 and is also described in an article entitled "Active Pixel Image Sensor Integrated With Readout Circuits" appearing in *NASA Tech Briefs*, October 1996, pp. 38 and 39. This particular article is also incorporated by reference.

Once image sensor 40 has created the pre-video signal, it is sent to  
10 the video processing board 50 for further processing. At board 50, as shown in Figure 4b, the pre-video signal is passed through a series of filters. One common filter arrangement may include two low pass filters 114 and 116, and a band pass filter 112. The band pass filter only passes low frequency components of the signal. Once these low frequency  
15 components pass, they are then sent to detector 120 and white balance circuit 124, the white balance circuit distinguishing between the colors of red and blue. The white balance circuit helps the imaging device set its normal, which is white. The portion of the signal passing through low pass filter 114 then travels through gain control 118 which reduces the  
20 magnitude or amplitude of this portion to a manageable level. The output from gain control 118 is then fed back to the white balance circuit 124. The portion of the signal traveling through filter 116 is placed through the processor 122. In the processor 122, the portion of the signal carrying the luminance or non-chroma is separated and sent to the Y chroma mixer 132.  
25 Any chroma portion of the signal is held in processor 122.

Referring to the output of the white balance circuit 124, this chroma portion of the signal is sent to a delay line 126 where the signal is then

further reduced by switch 128. The output of switch 128 is sent through a balanced modulator 130 and also to the Y chroma mixer 132 where the processed chroma portion of the signal is mixed with the processed non-chroma portion. Finally, the output from the Y chroma mixer 132 is sent to the NTSC/PAL encoder 134, commonly known in the art as a "composite" encoder. The composite frequencies are added to the signal leaving the Y chroma mixer 132 in encoder 134 to produce the post-video signal which may be accepted by a television.

Referring back to Figure 4, it further illustrates supplementary board 60 which may be used to digitally enhance or otherwise further condition the pre-video signal produced from image sensor 40. For example, digital enhancement can brighten or otherwise clarify the edges of an image viewed on a video screen. Additionally, the background images may be removed thus leaving only the foreground images or vice versa. The connection between image sensor 40 and board 60 may simply be the conductor 48 which may also transfer the pre-video signal to board 50. Once the pre-video signal has been digitally enhanced on supplementary board 60, it is then sent to the video processor board 50 by means of another conductor 51. The pre-video signal is an analog signal. The digitally enhanced pre-video signal may either be a digital signal or it may be converted back to the analog domain prior to being sent to board 50.

In addition to digital enhancement, supplementary board 60 may further include other circuitry which may further condition the post-video signal so that it may be viewed in a desired format other than NTSC/PAL. As shown in Figures 4, intermediate conductor 59 may transmit the signal output from Y chroma mixer 132 back to the supplementary board 60 where the signal is further encoded for viewing in a particular format. One



common encoder which can be used includes an RGB encoder 154. The RGB encoder separates the signal into three separate colors (red, green and blue) so that the surgeon may selectively choose to view only those images containing one or more of the colors. Particularly in tissue analysis where  
5 dyes are used to color the tissue, the RGB encoder may help the surgeon to identify targeted tissue.

The next encoder illustrated in Figure 4 is a SVHS encoder 156 (super video home system). This encoder splits or separates the luminance portion of the signal and the chroma portion of the signal prior to entering  
10 the video device. Some observers believe that a cleaner signal is input to the video device by such a separation which in turn results in a more clear video image viewed on the video device. The last encoder illustrated in Figure 4 is a VGA encoder 158 which enables the signal to be viewed on a standard VGA monitor which is common to many computer monitors.

15 One difference between the arrangement of image sensor 40 and the outputs found in Figure 3 of the Fossum, et al. patent is that in lieu of providing two analog outputs [namely, VS out (signal) and VR out (reset)], the reset function takes place in the timing and control circuitry 92. Accordingly, the pre-video signal only requires one conductor 48.

20 Figures 5a-5e illustrate in more detail one example of circuitry which may be used in the video processing board 50 in order to produce a post-video signal which may be directly accepted by a video device such as a television. The circuitry disclosed in Figures 5a-5e is very similar to circuitry which is found in a miniature quarter-inch Panasonic camera,  
25 Model KS-162. It will be understood by those skilled in the art that the particular arrangement of elements found in Figures 5a-5e are only exemplary of the type of video processing circuitry which may be

incorporated in order to take the pre-video signal and condition it to be received by a desired video device.

As shown in Figure 5a, 5 volt power is provided along with a ground by conductors 44 and 46 to board 50. The pre-video signal carried by conductor 48 is buffered at buffer 137 and then is transferred to amplifying group 138. Amplifying group 138 amplifies the signal to a usable level as well as achieving impedance matching for the remaining circuitry.

The next major element is the automatic gain control 140 shown in Figure 5b. Automatic gain control 140 automatically controls the signal from amplifying group 138 to an acceptable level and also adds other characteristics to the signal as discussed below. More specifically, automatic gain control 140 conditions the signal based upon inputs from a 12 channel digital to analog converter 141. Converter 141 retrieves stored information from EEPROM (electrically erasable programmable read only memory) 143. EEPROM 143 is a non-volatile memory element which may store user information, for example, settings for color, tint, balance and the like. Thus, automatic gain control 140 changes the texture or visual characteristics based upon user inputs. The signal leaving the automatic gain control 140 is an analog signal until being converted by analog to digital converter 142.

Digital signal processor 144 of Figure 5c further processes the converted signal into a serial type digital signal. One function of the microprocessor 146 is to control the manner in which digital signal processor 144 sorts the digital signals emanating from converter 142. Microprocessor 146 also controls analog to digital converter 142 in terms of when it is activated, when it accepts data, when to release data, and the

rate at which data should be released. Microprocessor 146 may also control other functions of the imaging device such as white balance. The microprocessor 146 may selectively receive the information stored in the EEPROM 143 and carry out its various commands to further control the other elements within the circuitry.

After the signal is processed by digital signal processor 144, the signal is sent to digital encoder 148 illustrated in Figure 5d. Some of the more important functions of digital encoder 148 are to encode the digital signal with synchronization, modulated chroma, blanking, horizontal drive, and the other components necessary so that the signal may be placed in a condition for reception by a video device such as a television monitor. As also illustrated in Figure 5d, once the signal has passed through digital encoder 148, the signal is reconverted into an analog signal through digital to analog converter 150.

This reconverted analog signal is then buffered at buffers 151 and then sent to amplifier group 152 of Figure 5e which amplifies the signal so that it is readily accepted by a desired video device. Specifically, as shown in Figure 5e, one SVHS outlet is provided at 160, and two composite or NTSC outlets are provided at 162 and 164, respectively.

From the foregoing, it is apparent that an entire imaging device may be incorporated within the distal tip of an endoscope, or may have some elements of the imaging device being placed in a small remote box adjacent to the endoscope. Based upon the type of image sensor used, the profile area of the imaging device may be made small enough to be placed into an endoscope which has a very small diameter tube. Additionally, the imaging device may be placed into the channels of existing endoscopes to provide additional imaging capability without increasing the size of the

endoscope. The imaging device may be powered by a standard power input connection in the form of a power cord, or a small lithium battery may be used.

- 5 This invention has been described in detail with reference to particular embodiments thereof, but it will be understood that various other modifications can be effected within the spirit and scope of this invention.

CLAIMS**What is claimed is:**

*Sub-D'* →

1. A reduced area imaging device comprising:
  - an image sensor lying in a first plane and including an array of pixels for receiving images thereon, said image sensor further including circuitry means on said first plane and coupled to said array of pixels for
  - 5 timing and control of said array of pixels, said image sensor producing a pre-video signal;
  - a pre-video conductor for transmitting said pre-video signal, said pre-video conductor having first and second ends, said first end communicating with said image sensor;
  - 10 a first circuit board lying in a second plane and longitudinally aligned with said image sensor, said first circuit board being connected to said pre-video conductor at said second end thereof, said first circuit board including circuitry means for converting said pre-video signal to a post-video signal for reception by a standard video device; and
  - 15 a power supply electrically coupled with said image sensor for driving said array of pixels and said timing and control means, and electrically coupled to said first circuit board for driving said circuit board.
2. A reduced area imaging device, as claimed in claim 1, wherein:
  - said image sensor defines a profile area in said first plane,
  - and said first circuit board being positioned so as not to extend
  - 5 substantially beyond said profile area.



3. A reduced area imaging device, as claimed in claim 1, further including:

a second circuit board electrically coupled with said first circuit board and said image sensor for enhancing said pre-video signal prior to reception by said <sup>first</sup> circuit board, said second circuit board being longitudinally aligned with said first circuit board and said image sensor so as not to extend substantially beyond said profile area.

4. A reduced area imaging device, as claimed in claim 1, wherein:

said first and second planes are offset from and substantially parallel to one another.

5. A reduced area imaging device, as claimed in claim 3, wherein:

said second circuit board lies in a third plane which is offset from and extends substantially parallel to said first and second planes.

*Sub D2* 6. A reduced area imaging device comprising:  
 an image sensor lying in a first plane and including an array of pixels for receiving images thereon, said image sensor further including circuitry means on said first plane and coupled to said array of pixels for timing and control of said array of pixels, said image sensor producing a pre-video signal;  
 a control box remote from said image sensor, said control box including circuitry means for receiving said pre-video signal from said

- image sensor, and for converting said pre-video signal to a post-video  
 10 signal which may be received by a standard video device; and  
     a power supply coupled to said control box and said image  
 sensor for providing power thereto.

7. A reduced area imaging device, as claimed in claim 6,  
 wherein said control box further includes:

- a supplementary circuit board for digitally enhancing the pre-  
 video signal, said supplementary circuit board coupled to said circuitry  
 5 means for receiving said pre-video signal and for converting said pre-video  
 signal.

ADDA1

add C<sup>2</sup>

ADDF2

ABSTRACT

A reduced area imaging device is provided for use in medical or dental instruments such as an endoscope. In one configuration of the imaging device, the image sensor is placed remote from the remaining  
5 circuitry. In another configuration, all of the circuitry to include the image sensor is placed in a stacked fashion at the same location. In a first embodiment of the invention, the entire imaging device can be placed at the distal tip of an endoscope. In a second embodiment, the image sensor is remote from the remaining circuitry according to the first configuration,  
10 and wherein a control box can be provided which communicates with the image sensor and is placed remotely from the endoscope. In yet another embodiment, the imaging device can be incorporated in the housing of a standard medical camera which is adapted for use with traditional rod lens endoscopes. In any of the embodiments, the image sensor may be placed  
15 alone on a first circuit board, or timing and control circuits may be included on the first circuit board containing the image sensor. One or more video processing boards can be stacked in a longitudinal fashion with respect to the first board, or the video processing boards may be placed in the control box.

175-685-1003

Please type a plus sign (+) inside this box → ☒**DECLARATION FOR UTILITY OR  
DESIGN PATENT APPLICATION  
(37 CFR 1.63)**

☒ Declaration Submitted with Initial Filing    ☐ Declaration Submitted after Initial Filing (surcharge [37 CFR 1.16(e)] required)

Attorney Docket Number: F97.13 CIP2  
First Named Inventor: Edwin L. Adair, et al.

**COMPLETE IF KNOWN**

Application Number: \_\_\_\_\_  
Filing Date: \_\_\_\_\_  
Group Art Unit: \_\_\_\_\_  
Examiner Name: \_\_\_\_\_

**As a below named inventor, I hereby declare that:**

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

"Reduced Area Imaging Devices"

the specification of which

☒ is attached hereto

OR

☐ was filed on (MM/DD/YY) \_\_\_\_\_ as United States Application Number or PCT International Application Number \_\_\_\_\_ as was amended on (MM/DD/YY) \_\_\_\_\_ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR § 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or Inventor's certificate, or 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or Inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

**Prior Foreign Application(s)**

(Number)	(Country)	(Foreign Filing Date)	Priority Not Claimed	Certified Copy Attached ?	
				Yes	No
_____	_____	_____	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
_____	_____	_____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached.

I hereby claim the benefit under 35 U.S.C. 119(e) of the United States provisional application(s) listed below.

(Application Number)	(Filing Date)
_____	_____
_____	_____

☐ Additional provisional application numbers are listed on supplemental priority data sheet PTO/SB/02B attached hereto.

I hereby claim the benefit under 35 U.S.C. §120 of any United States application(s), or §365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 C.F.R. 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application.

<u>08/944,322</u>	<u>October 6, 1997</u>	<u>pending</u>
U.S. Parent Application or PCT Parent Number	Parent Filing Date	Parent Patent Number (if applicable)

U.S. Parent Application or PCT Parent Number	Parent Filing Date	Parent Patent Number (if applicable)
---	--------------------	---

☐ Additional U.S. or PCT International application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached.

As named inventor, I hereby appoint the following practitioner(s) to prosecute this application and to transact all business in the

Patent and Trademark Office connected therewith: ☒ Registered Practitioner(s) name/registration number listed below

Name	Registration Number
<u>Gary D. Fields</u>	<u>19,604</u>
<u>Brent P. Johnson</u>	<u>38,031</u>

☐ Additional registered practitioner(s) named on Supplemental Registered Practitioner Information sheet PTO/SB/02C attached hereto.

Direct all correspondence to: Fields & Johnson, P.C.  
1700 Lincoln Street, Suite 3030, Denver, CO 80203  
Country: U.S.A. Telephone: (303) 861-9100 Fax: (303) 861-9111

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name of Sole or First Inventor

☐ A petition has been filed for this unsigned inventor  
Given Name (first and middle [if any]) Edwin L. Family Name or Surname Adair

Inventor's signature Edwin L. Adair Date Oct 10 1998  
Residence 317 Paragon Way Citizenship U.S.A.  
Post Office Address 317 Paragon Way  
City, State, Zip, Country Castle Pines Village, CO 80104  
Full name of second joint inventor, if any (given name, family name) Jeffrey L. Adair  
Second Inventor's signature Jeffrey L. Adair Date 10-30-98  
Residence 1861 East Redfox Place Citizenship U.S.A.  
Post Office Address 1861 East Redfox Place  
City, State, Zip, Country Highlands Ranch, CO 80126

☒ Additional inventors are being named on separately numbered sheets attached hereto.



DECLARATION FOR PATENT APPLICATION

Attorney Docket No. F97.13.CIP2

Full name of third joint inventor, if any (given name, family name) Randall S. Adair  
Third Inventor's signature *Randall S. Adair* Date 10-20-98  
Residence 3082 South Flamingo Way Citizenship U.S.A.  
Post Office Address 3082 South Flamingo Way  
Denver, CO 80222

10175685-102748

Applicant or Patentee: Edwin L. Adair, Jeffrey L. Adair, Randall S. Adair Attorney's  
 Serial No. or Patent No.: \_\_\_\_\_ Docket No.: F97.13CIP2  
 Filed or Issued: \_\_\_\_\_  
 For: "Reduced Area Imaging Devices"

**VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY  
 STATUS (37 CFR 1.9(f) AND 1.27(b)) - INDEPENDENT INVENTOR**

As a below named inventor, I hereby declare that I qualify as an independent inventor as defined in 37 CFR 1.9(c) for purposes of paying reduced fees under Section 41(a) and (b) of Title 35, United States Code, to the Patent and Trademark Office with regard to the invention entitled \_\_\_\_\_  
"Reduced Area Imaging Devices"  
 described in:

- ☒ the specification filed herewith.  
☐ application serial no. \_\_\_\_\_, filed \_\_\_\_\_  
☐ patent no. \_\_\_\_\_, issued \_\_\_\_\_

I have not assigned, granted, conveyed or licensed and am under no obligation under contract or law to assign, grant, convey or license, any rights in the invention to any person who could not be classified as an independent inventor under 37 CFR 1.9(c) if that person had made the invention, or to any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

Each person, concern or organization to which I have assigned, granted, conveyed, or licensed or am under an obligation under contract or law to assign, grant, convey or license any rights in the invention is listed below:

- ☒ no such person, concern or organization.

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate (37 CFR 1.28(b)).

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

Edwin L. Adair  
 NAME OF INVENTOR:

Jeffrey L. Adair  
 NAME OF INVENTOR:

Randall S. Adair  
 NAME OF INVENTOR:

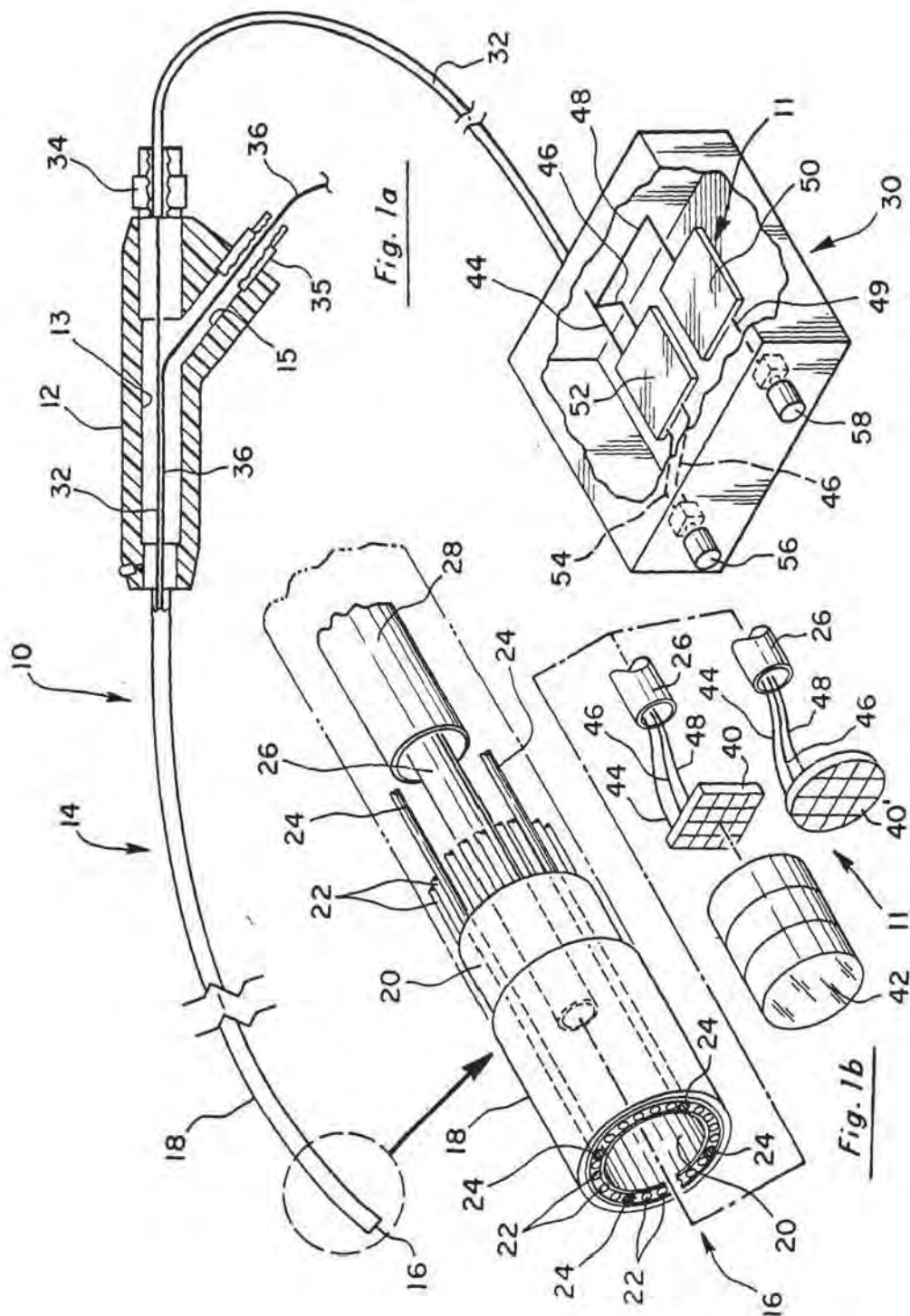
Edwin L. Adair  
 Signature of Inventor:

Jeffrey L. Adair  
 Signature of Inventor:

Randall S. Adair  
 Signature of Inventor:

$$\begin{array}{r} 348 \\ \hline 76 \end{array}$$

1/11



2/11

Fig. 2a

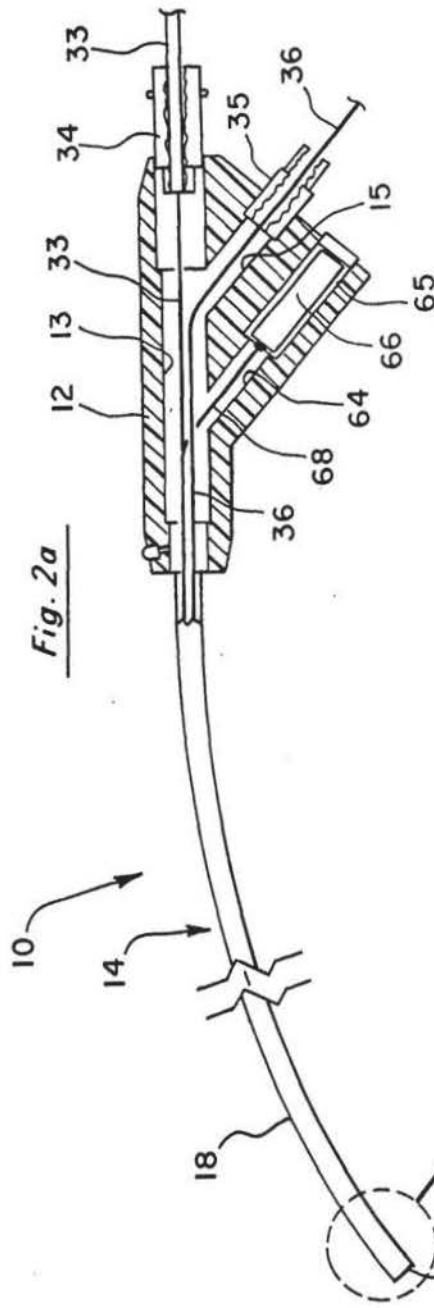
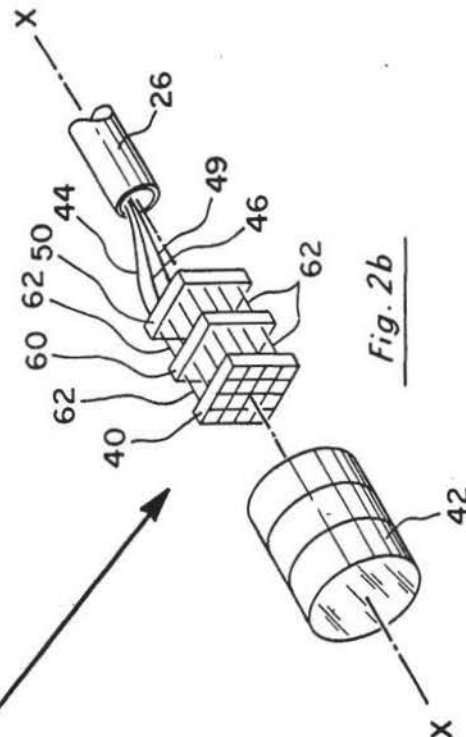
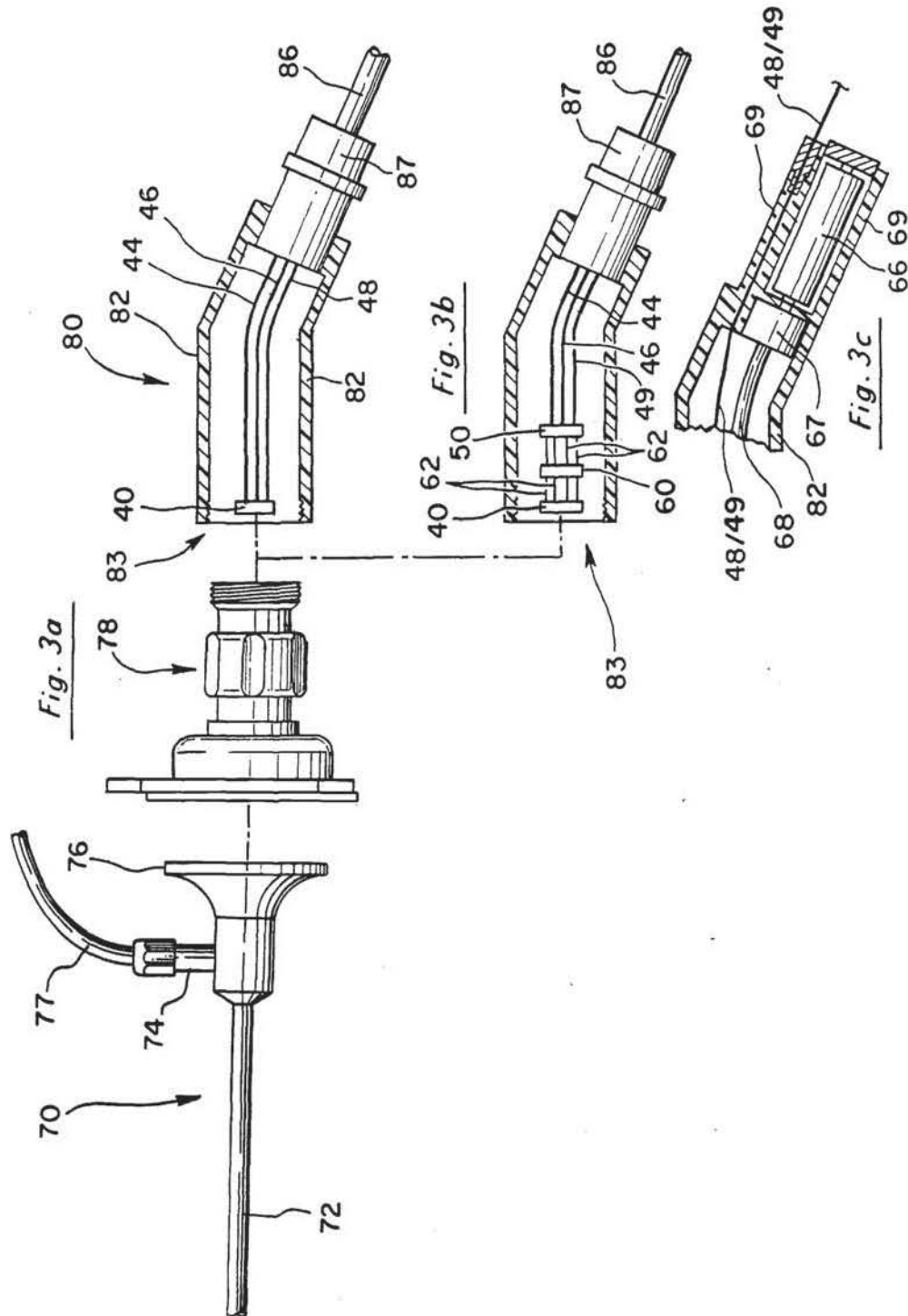


Fig. 2b



3/11

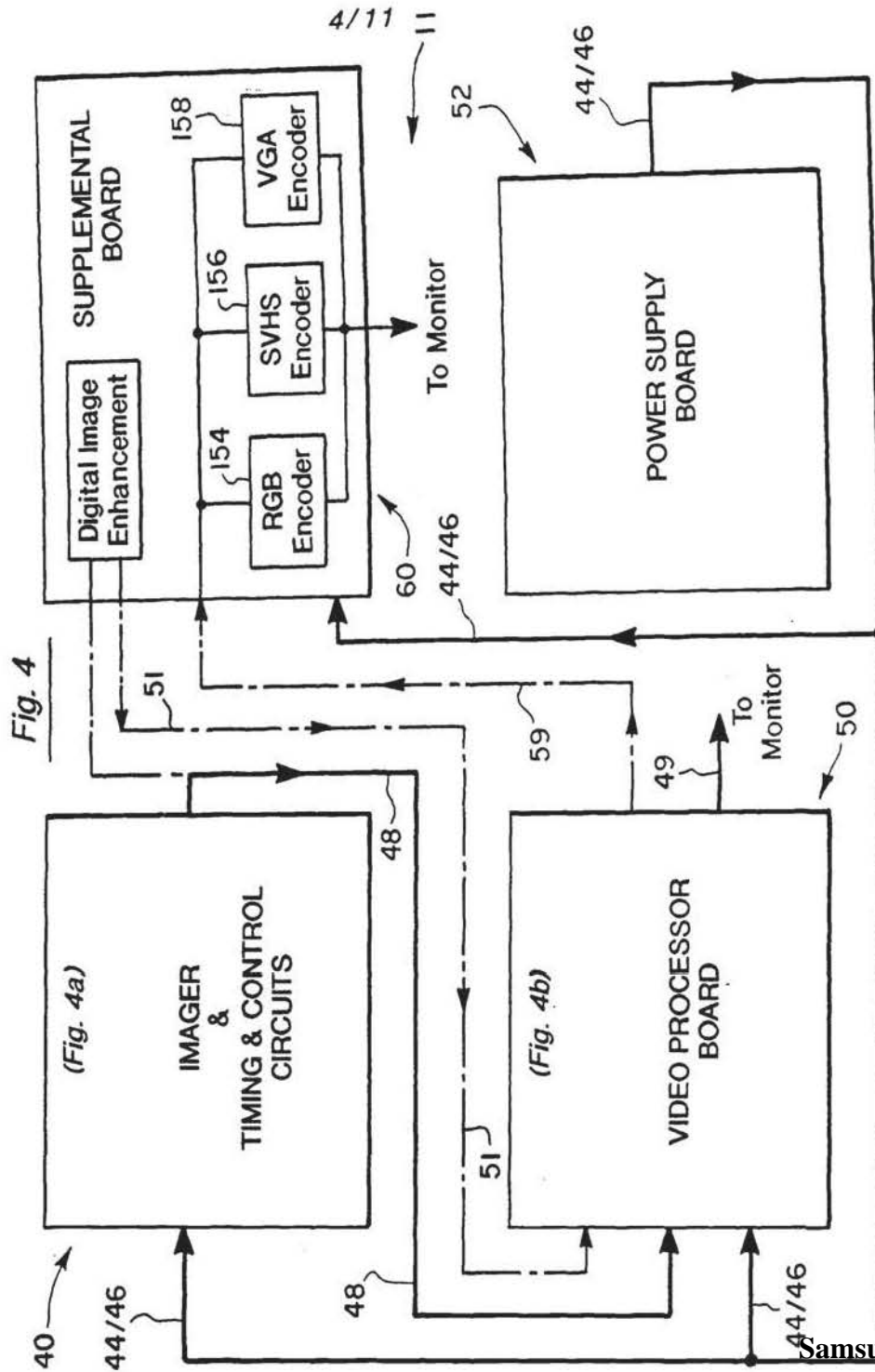
860201-5895/T60



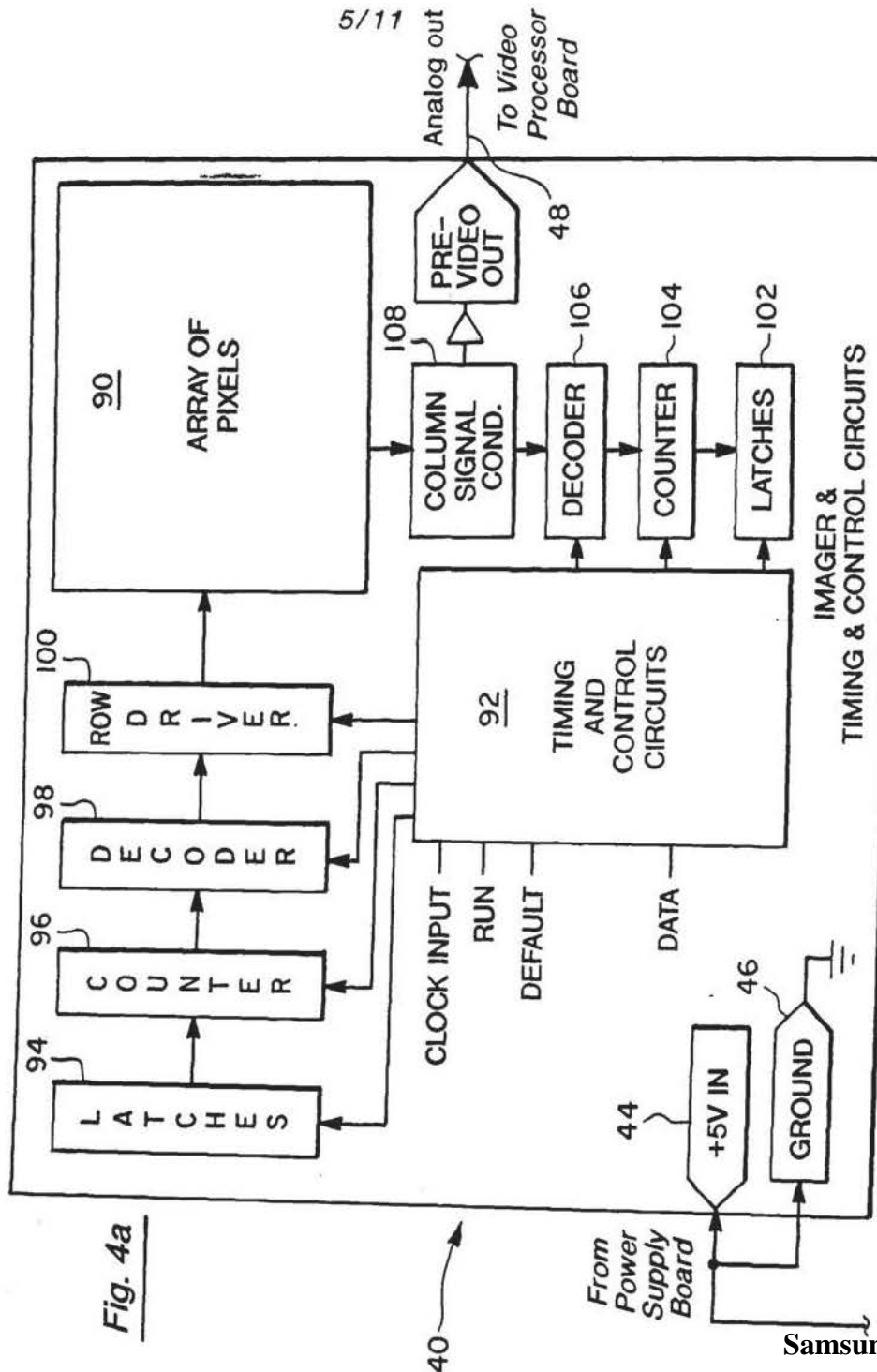


860201-58957160

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860201-5895/T60



PRINT OF DRAWINGS  
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6/11

860201-5895ZT60

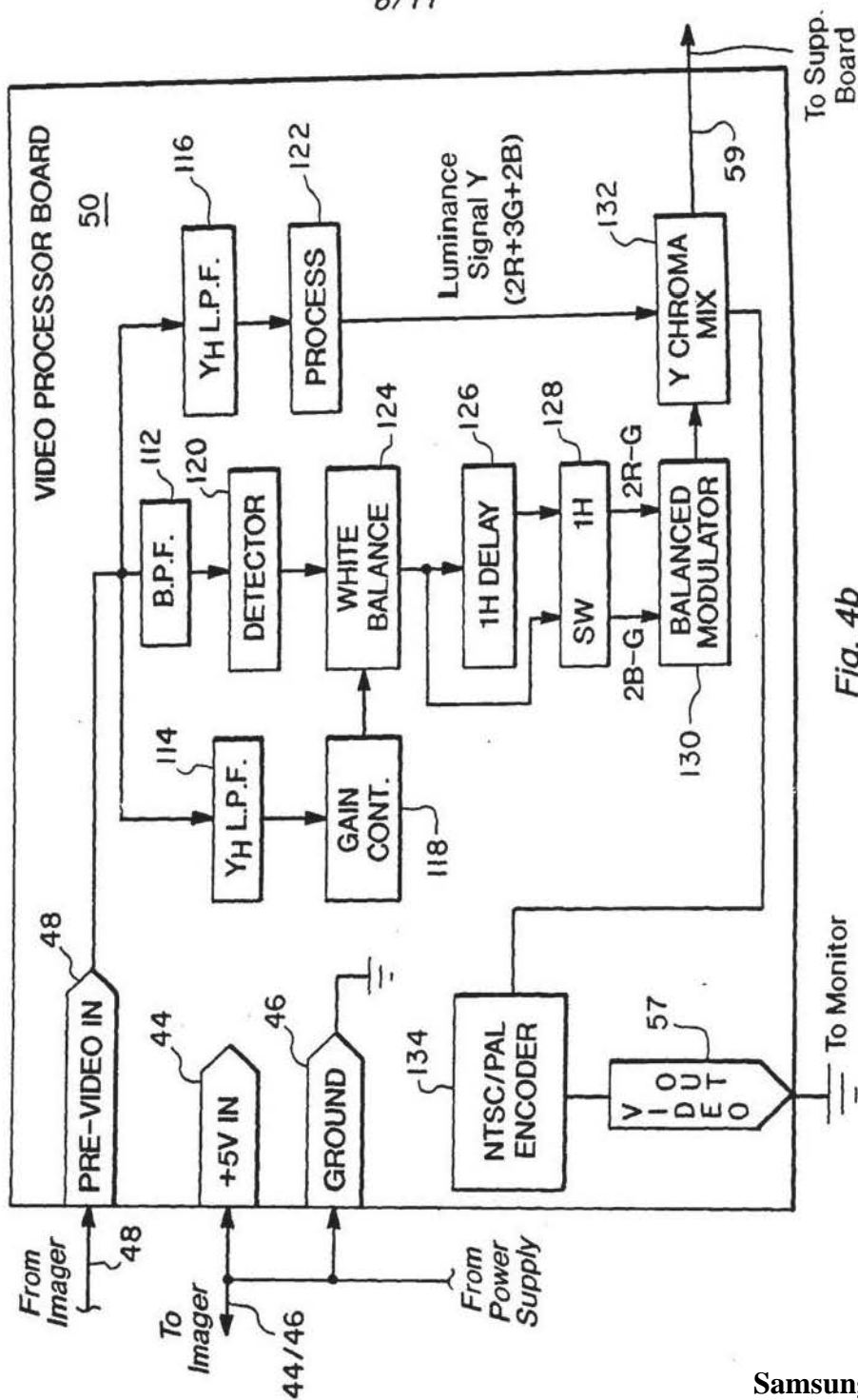
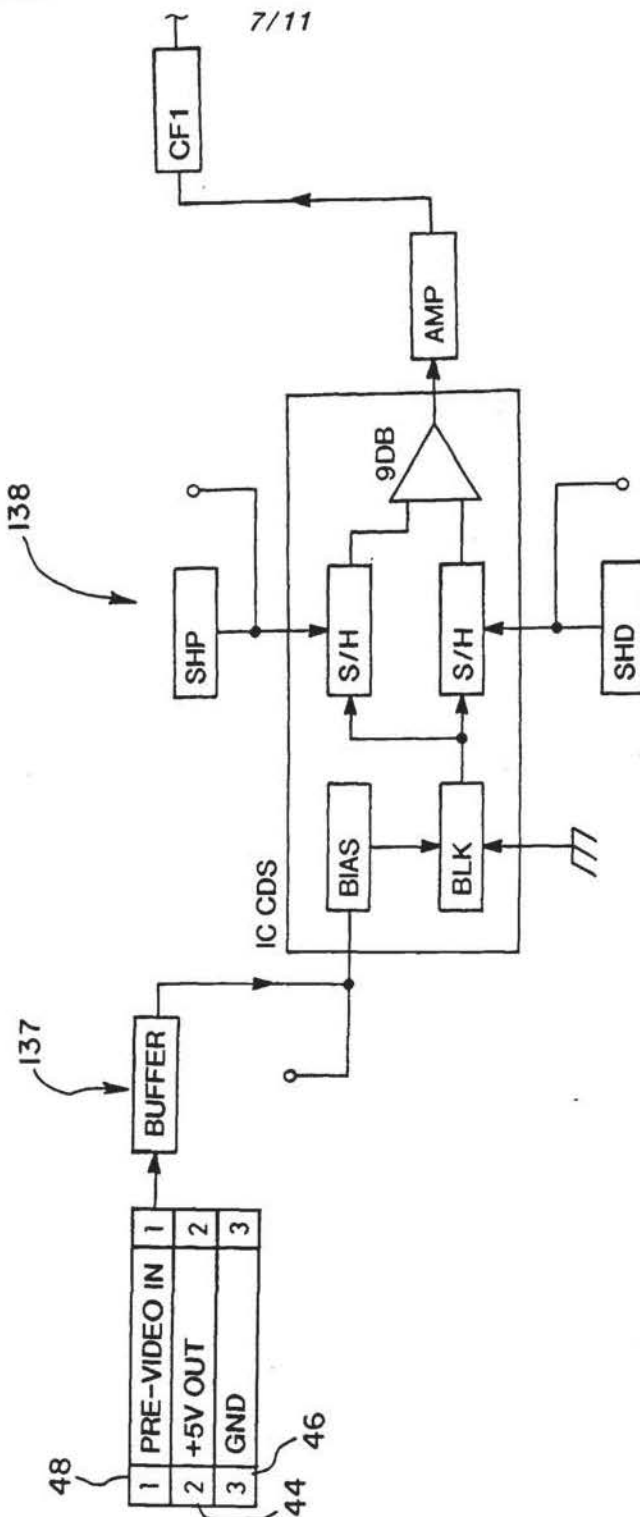


Fig. 4b

860201-5895/T60

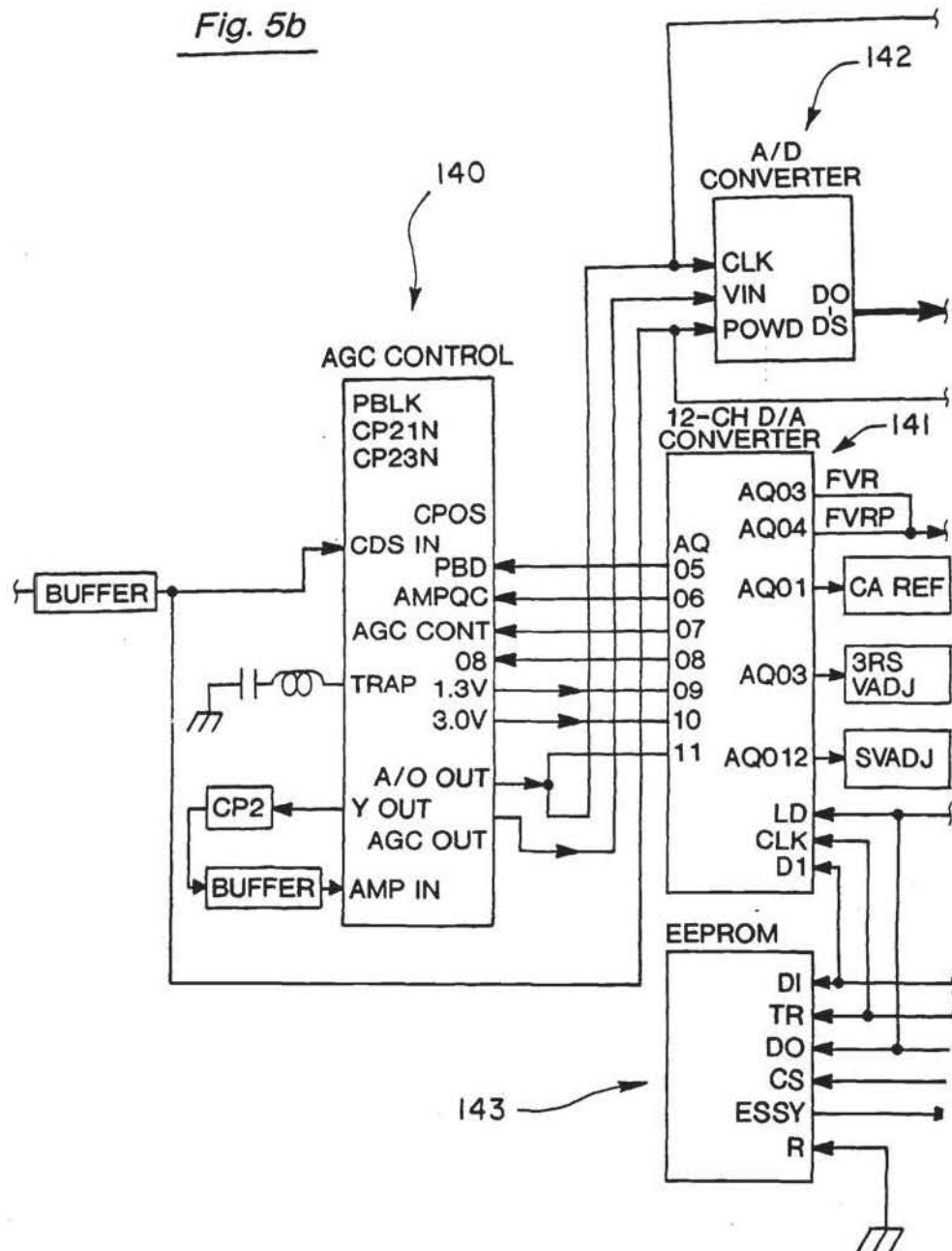
Fig. 5a



8/11

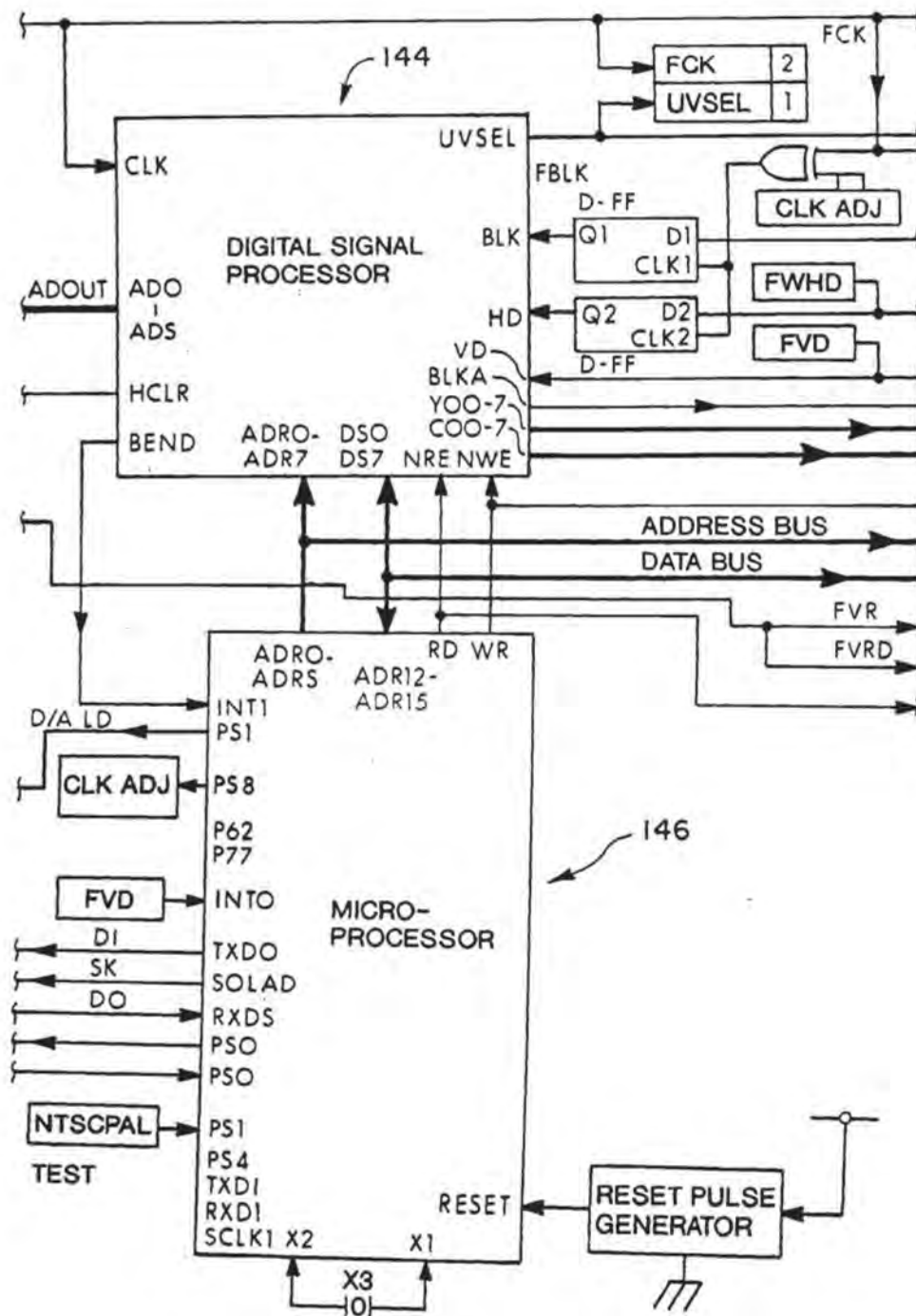
Fig. 5b

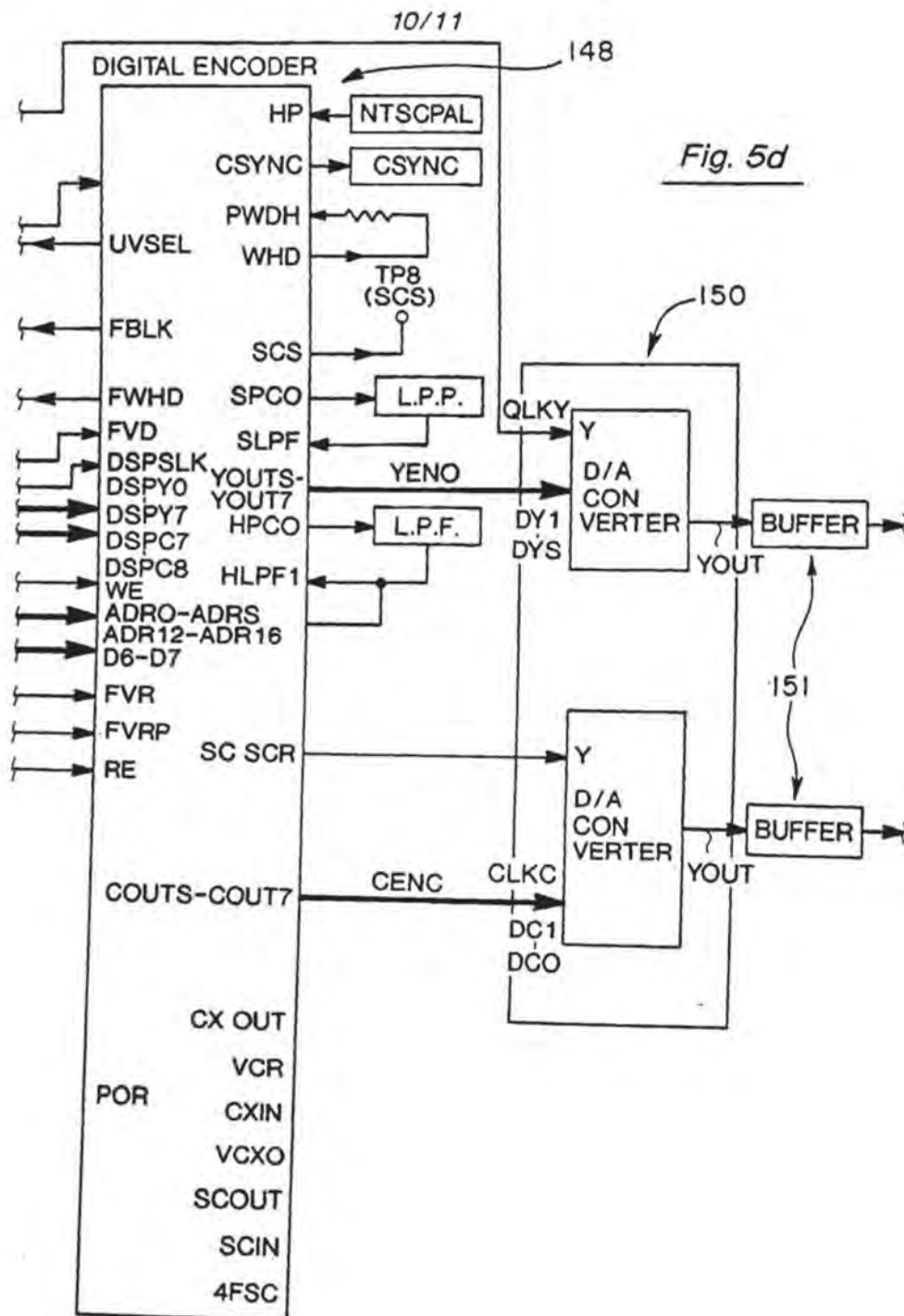
09175685.102098





9/11 Fig. 5c

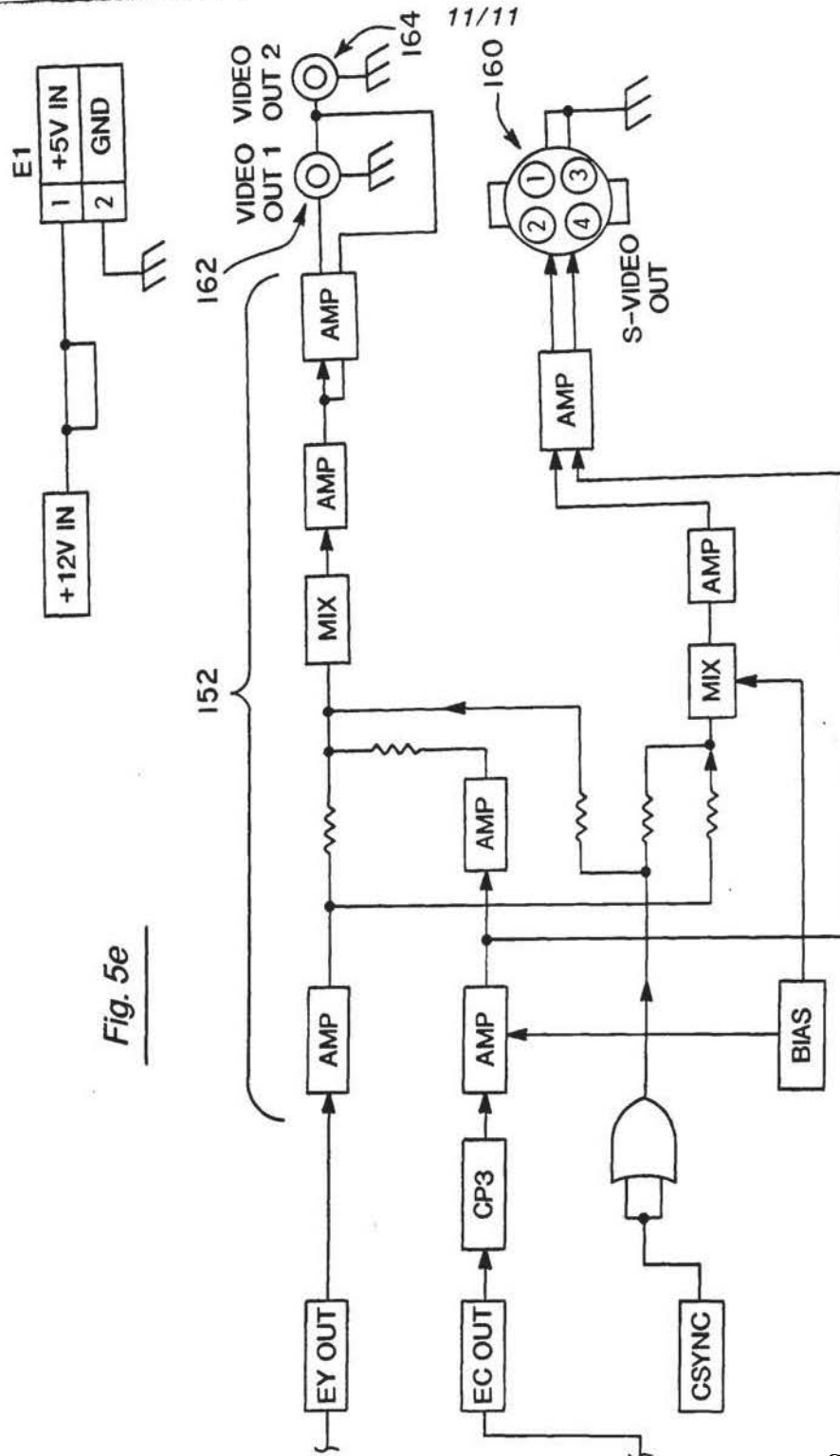




860201-58954160

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Fig. 5e

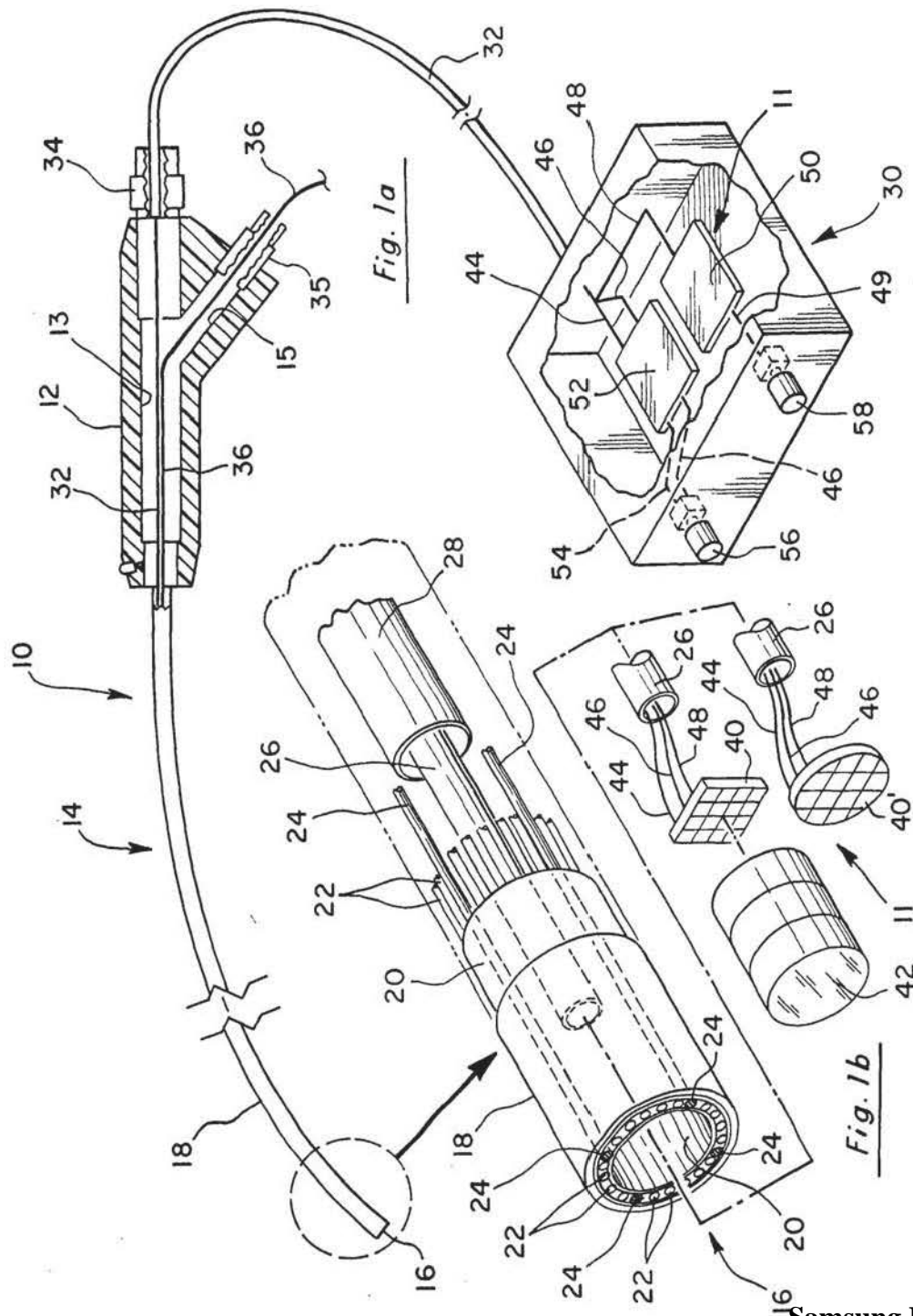


IMPROVED D.G. FIG. 1  
 CLASS SUBCLASS  
 DRAFTSMAN 348 76

6043839

1/11

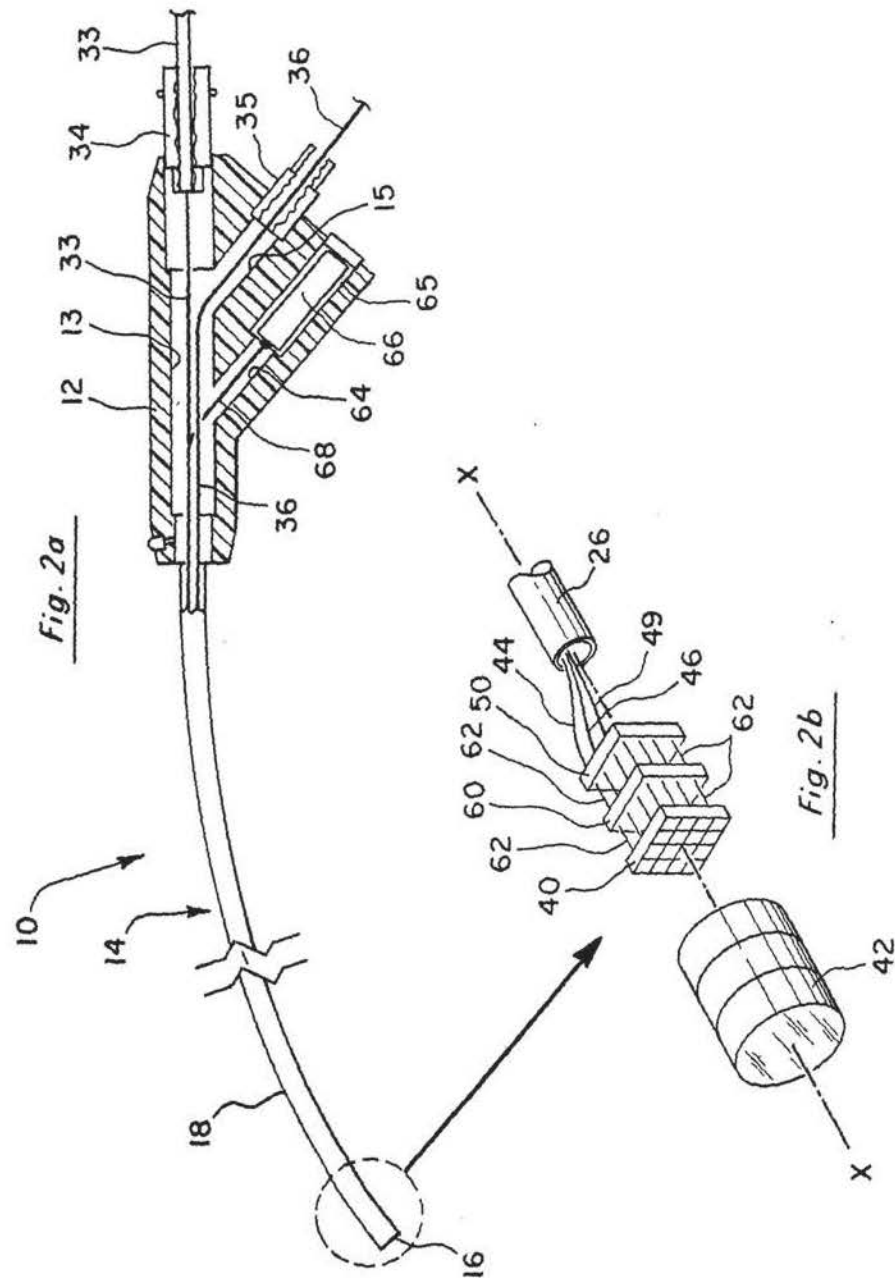
860201-5895/T60



APPROVED	O.G. FIG.
37	CLASS
DRAFTSMAN	SUBCLASS

2/11

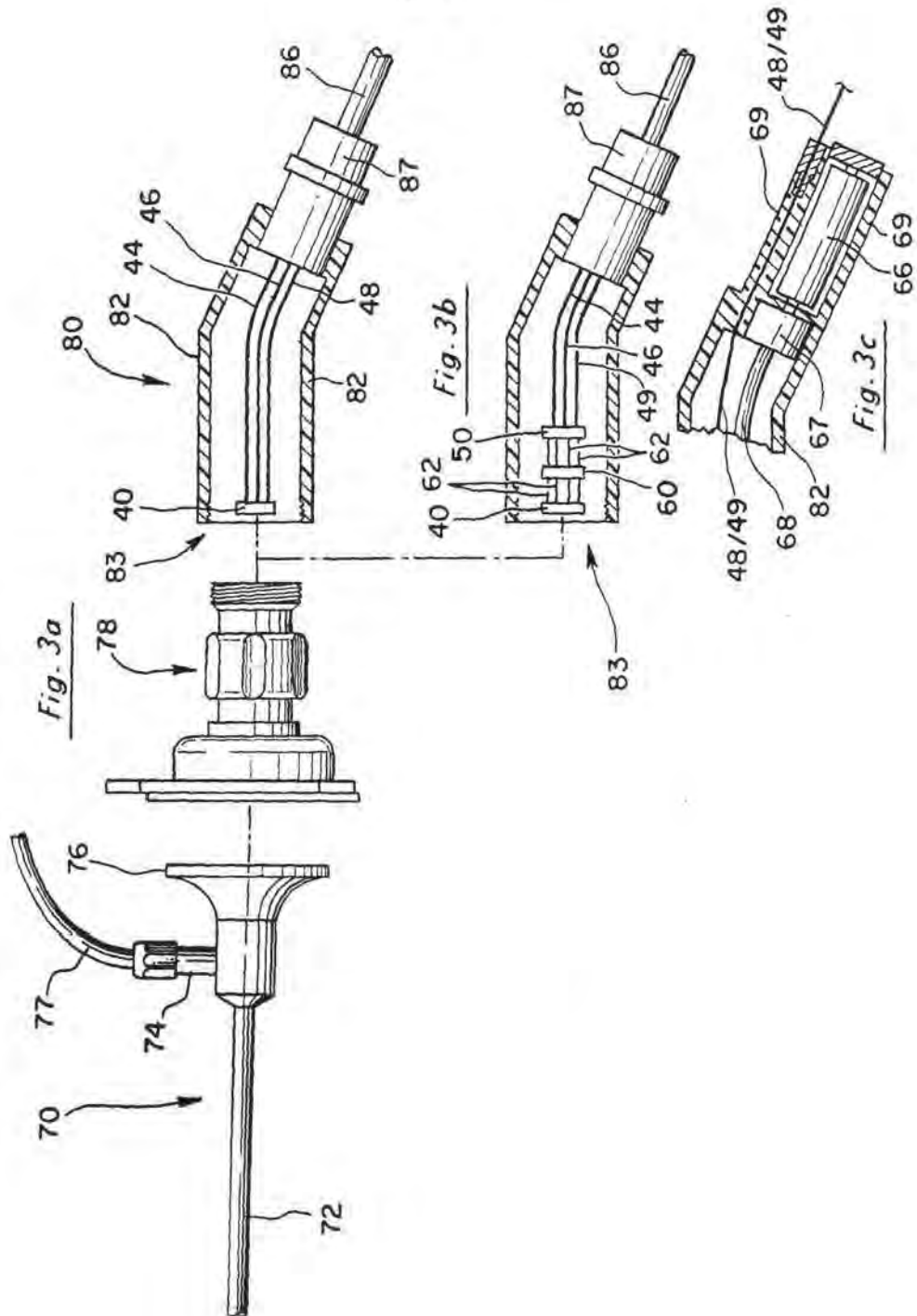
860201-58957150



APPROVED	(13) FIG.
BY	CLASS SUBCLASS
DRAFTSMAN	

3/11

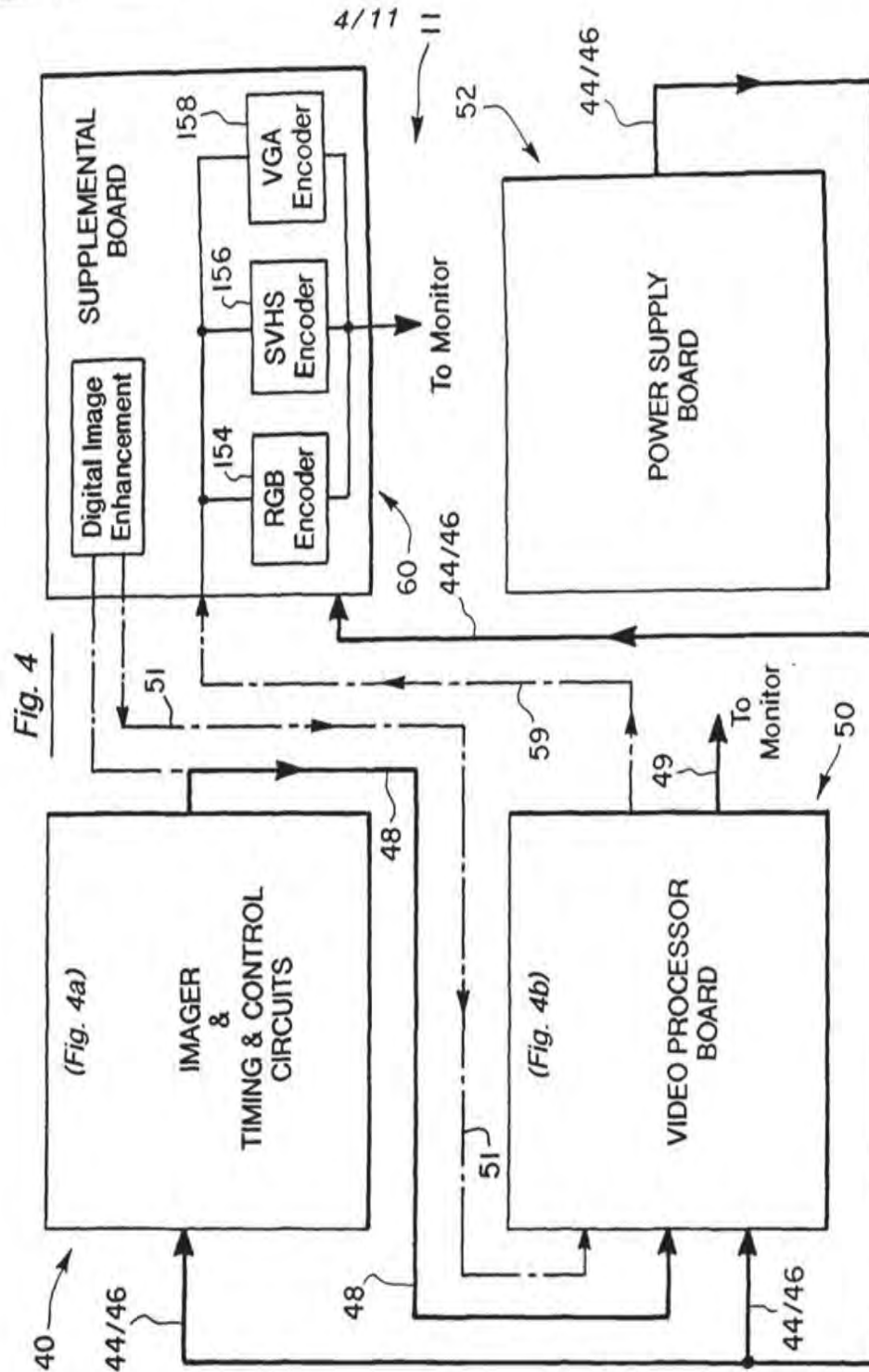
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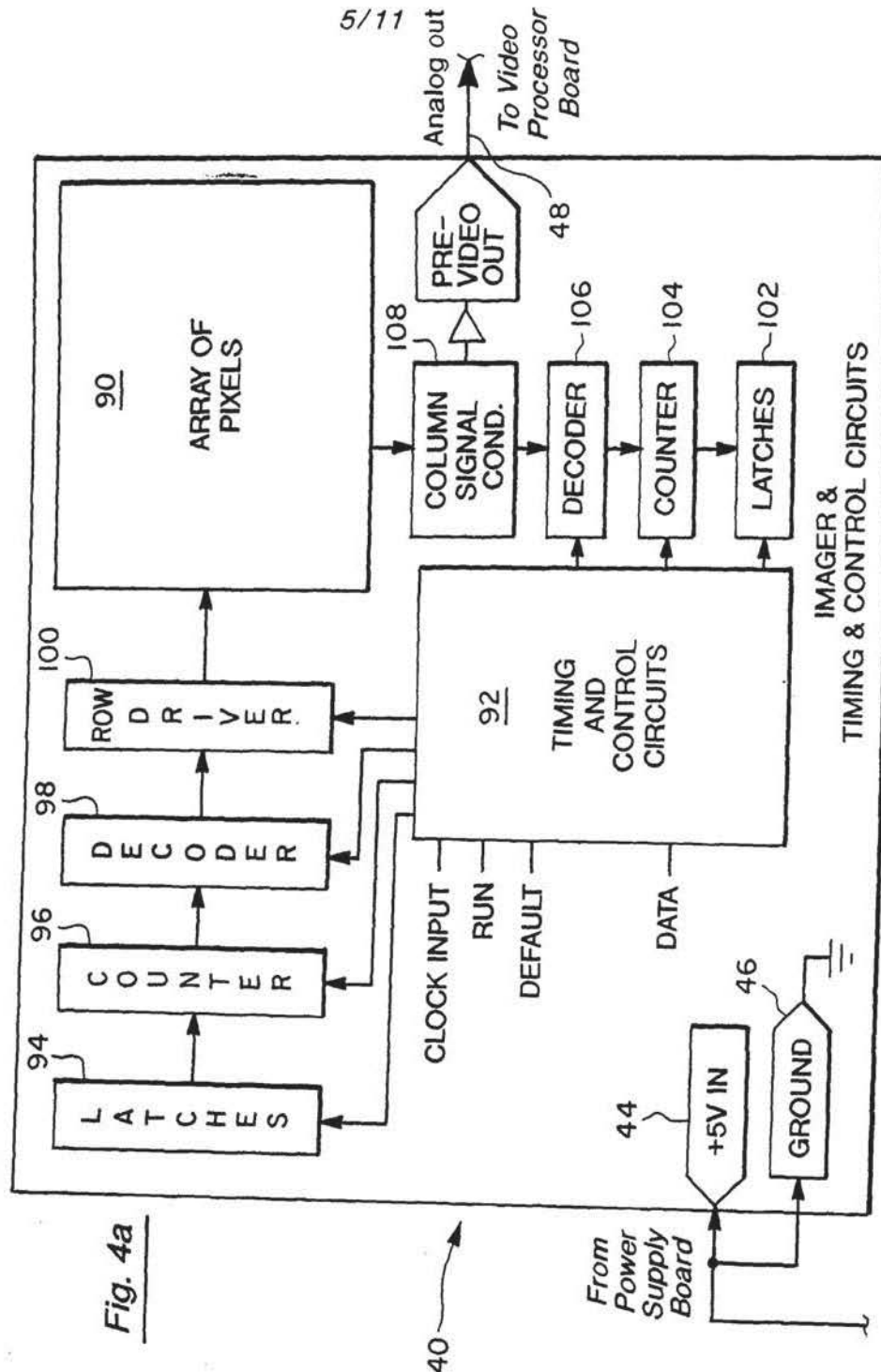
APPROVED	O.G. FIG.	
BY	CLASS	SUBCLASS
DRAFTSMAN		

09175685.102098



APPROVED	O.T. FIG.	
BY	CLASS	SUBCLASS
DRAFTSMAN		

860201" 58954T60



APPROVED	O.G. FIG.	
BY	CLASS	SUBCLASS
DRAFTSMAN		

6/11

860201-58957160

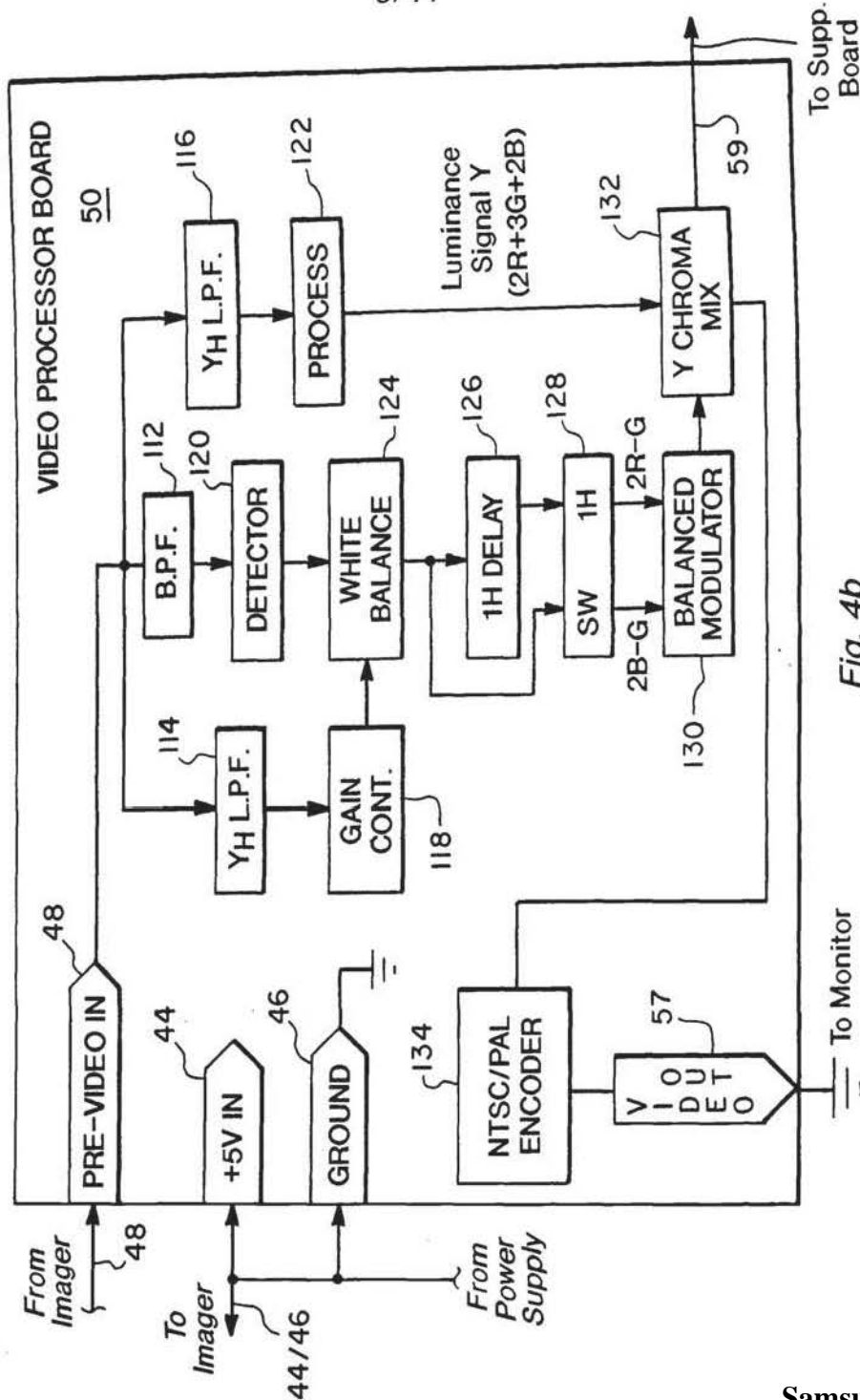
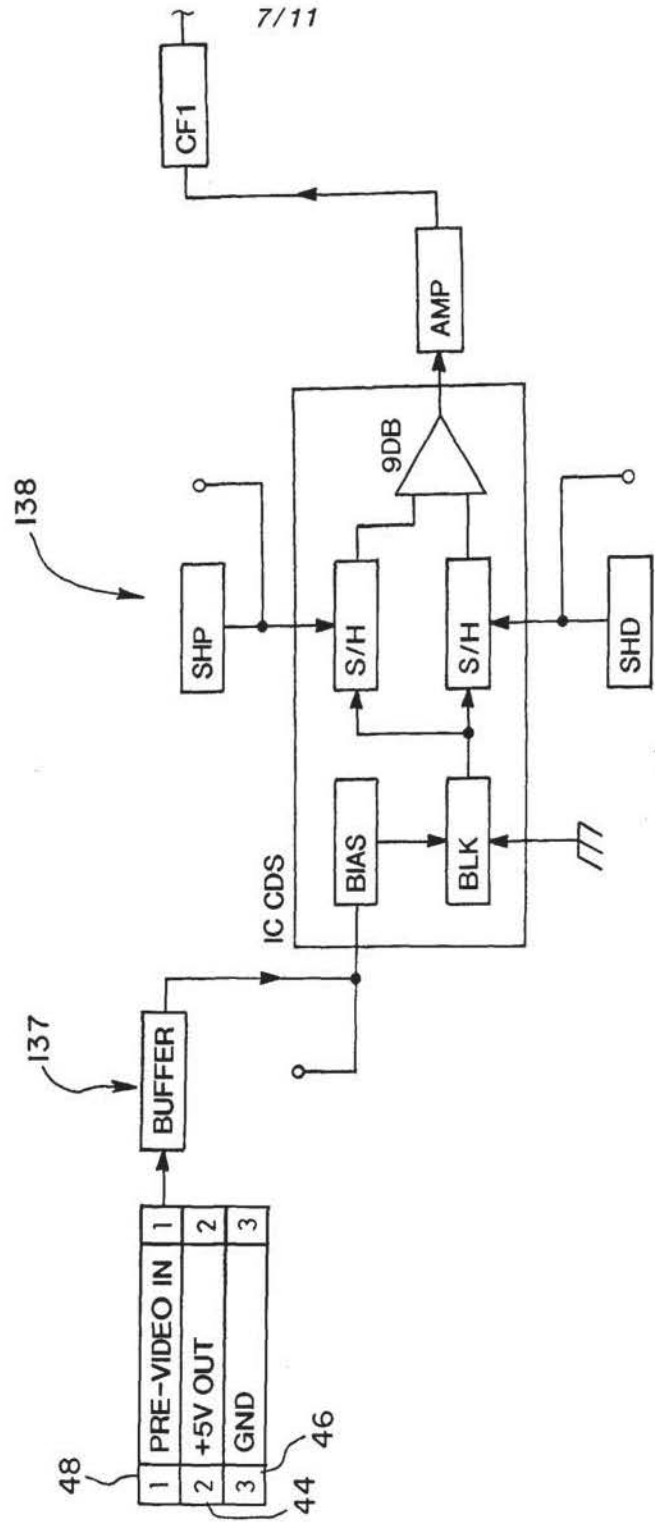


Fig. 4b

APPROVED	O.G. FIG.
BY	CLASS SUBCLASS
DRAFTSMAN	

86020T-5895/T60

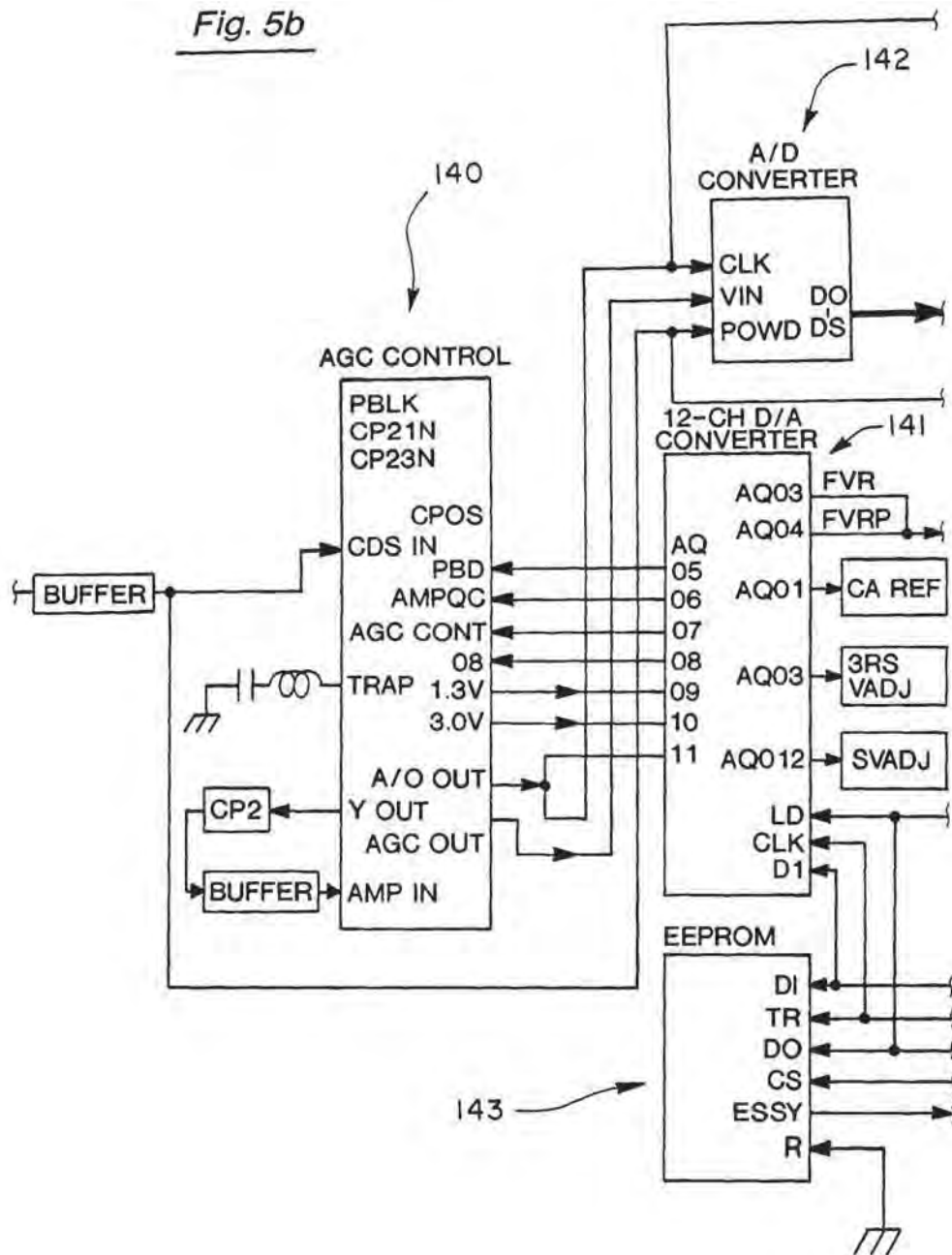
Fig. 5a



APPROVED	O.G. FIG.
CLASS	SUBCLASS
DRAFTSMAN	

8/11

Fig. 5b

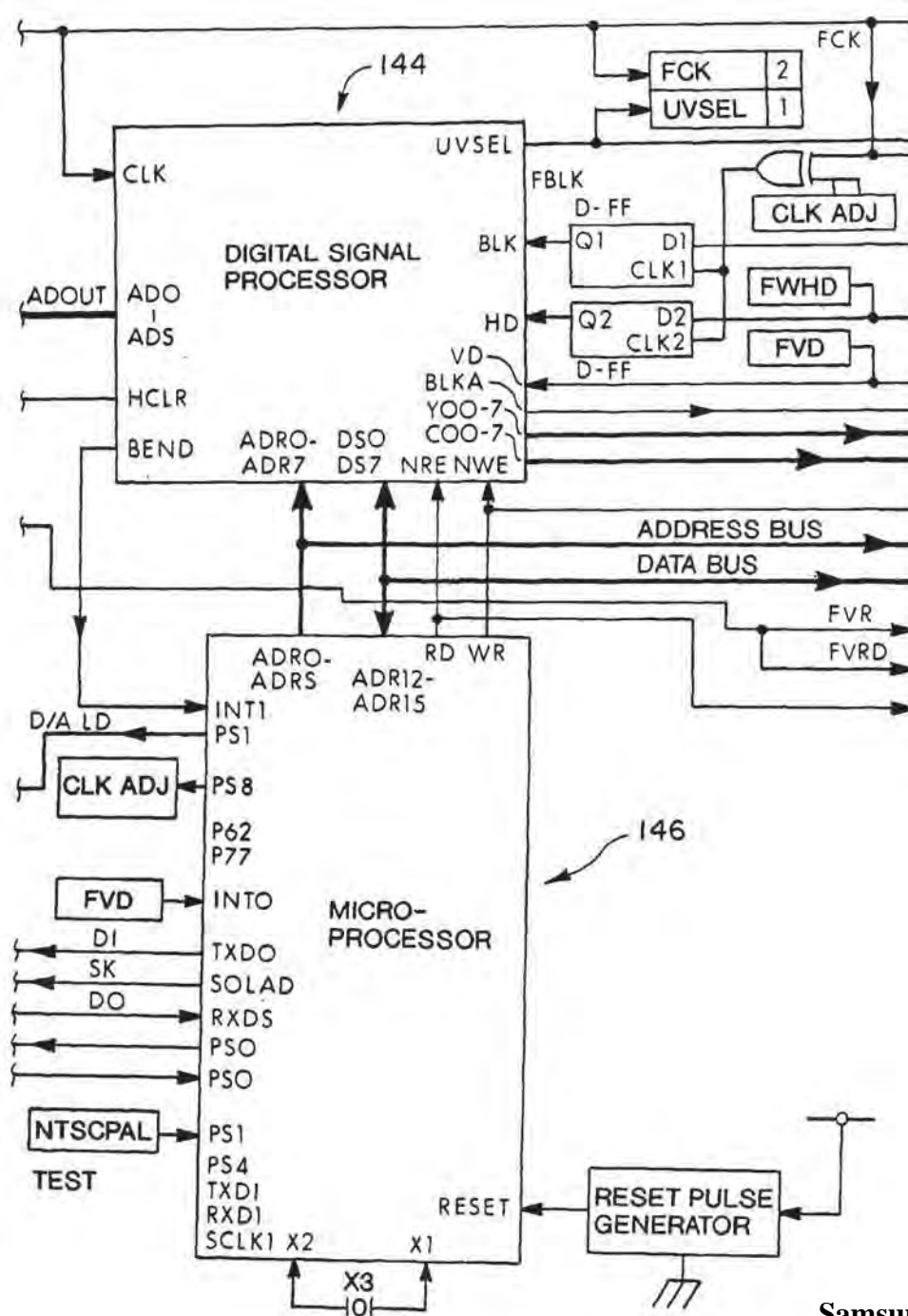


09175685-102098

APPROVED	O.G. FIG.
BY	CLASS SUBCLASS
DRAFTSMAN	

9/11 Fig. 5c

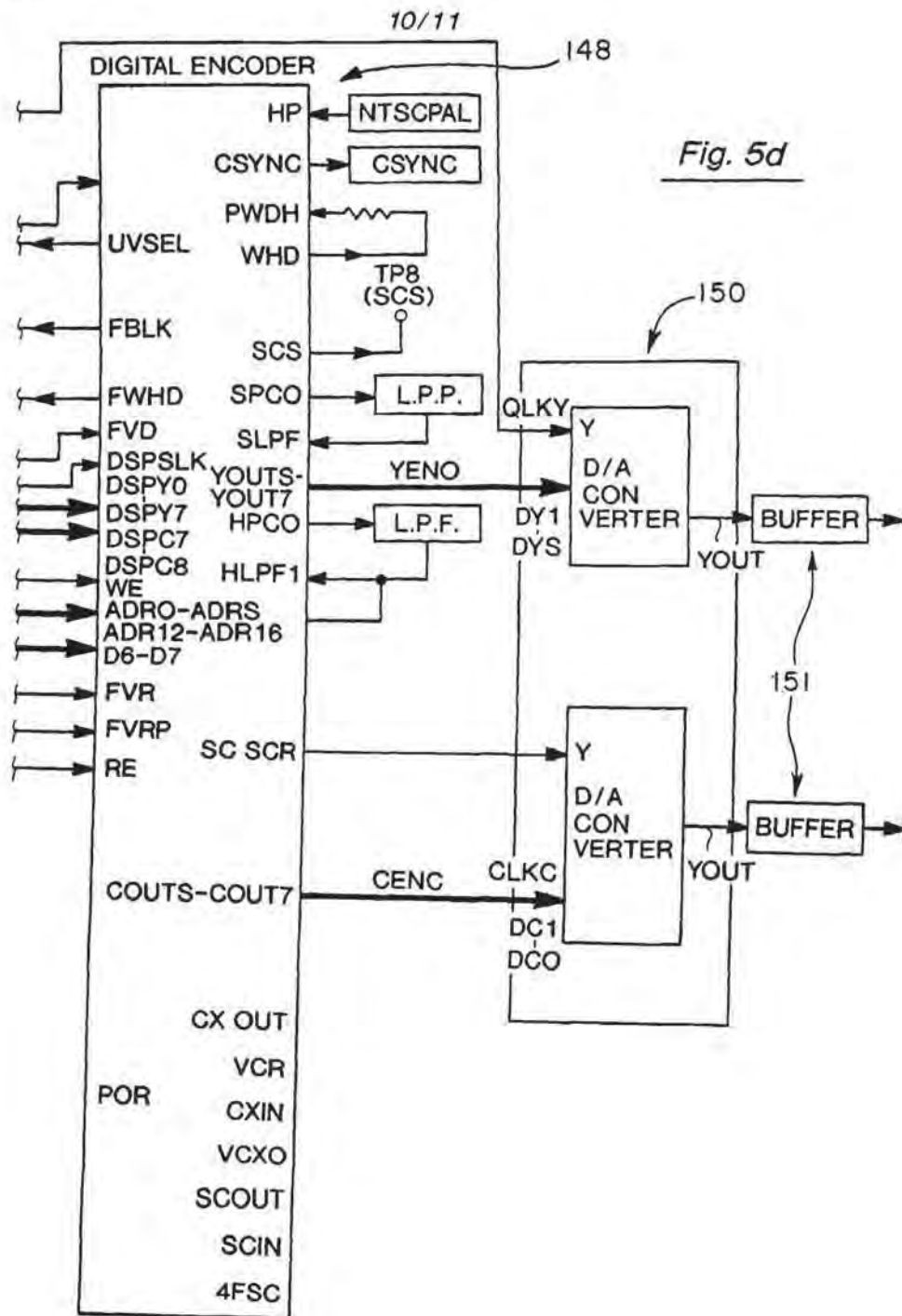
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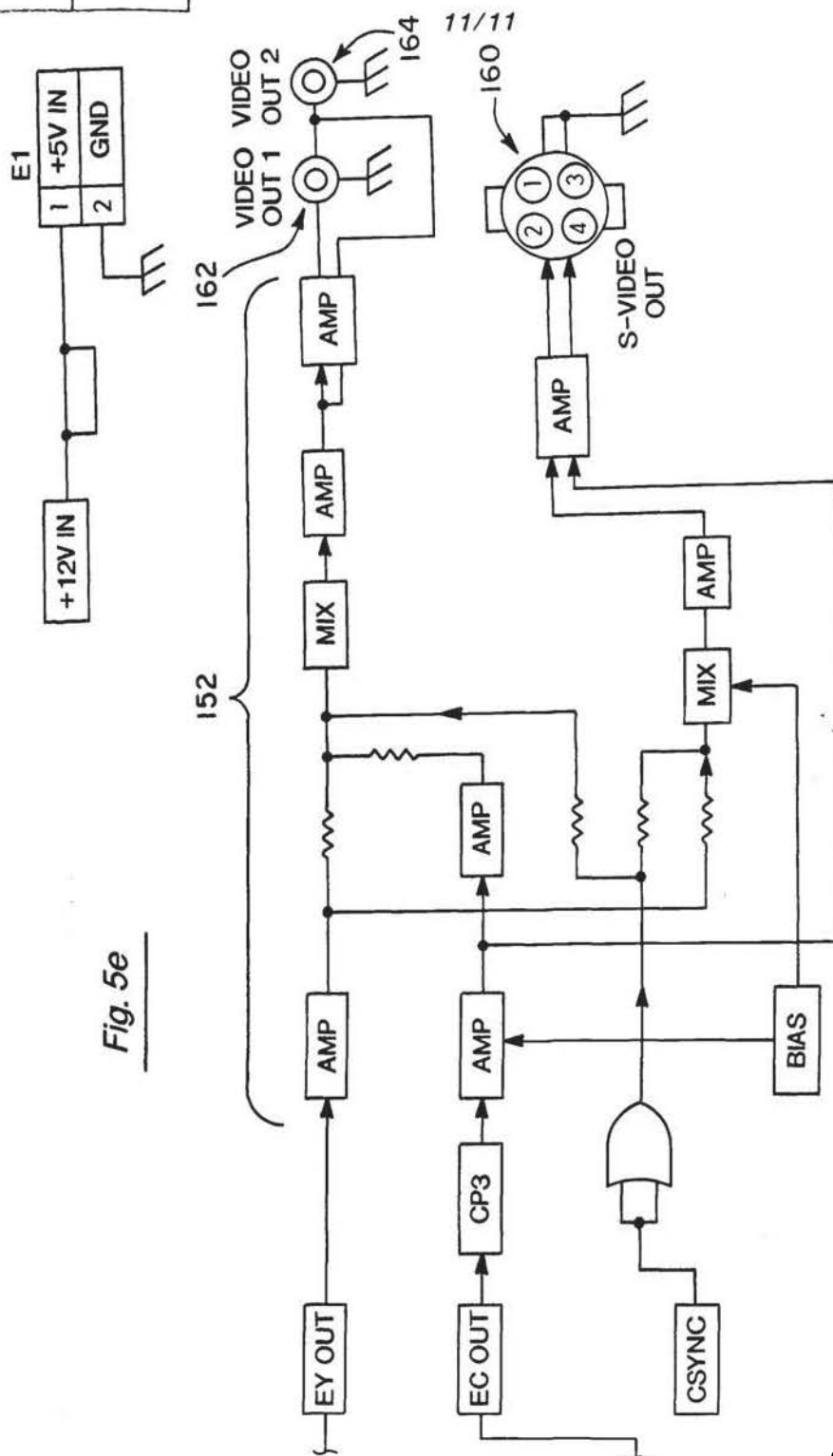
APPROVED	D.G. FIG.	
CLASS	SUBCLASS	
DRAFTSMAN		

09175685-102098



APPROVED	O.G. FIG.	
BY	CLASS	SUBCLASS
DRAFTSMAN		

09175685.102098



1012003/127UB  
K. P. M. W. B.

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Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

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# TRANSMITTAL FORM

to be used for all correspondence after initial filing)

Total Number of Pages in This Submission 283

Application Number 09/175,685  
Filing Date 10/20/98  
First Named Inventor Edwin L. Adair, et al.  
Group Art Unit RECEIVED  
Examiner Name FEB 25 1999  
Attorney Docket Number F97-13 CIP2  
GROUP 2700

## ENCLOSURES (check all that apply)

- ☐ Fee Transmittal Form
- ☐ Fee Attached
- ☐ Amendment / Response
  - ☐ After Final
  - ☐ Affidavits/declaration(s)
- ☐ Extension of Time Request
- ☐ Express Abandonment Request
- ☒ Information Disclosure Statement
- ☐ Certified Copy of Priority Document(s)
- ☐ Response to Missing Parts/Incomplete Application
  - ☐ Response to Missing Parts under 37 CFR 1.52 or 1.53

- ☐ Assignment Papers (for an Application)
- ☐ Drawing(s)
- ☐ Licensing-related Papers
- ☐ Petition Routing Slip (PTO/SB/69) and Accompanying Petition
- ☐ Petition to Convert to a Provisional Application
- ☐ Power of Attorney, Revocation Change of Correspondence Address
- ☐ Terminal Disclaimer
- ☐ Small Entity Statement
- ☐ Request for Refund

- ☐ After Allowance Communication to Group
- ☐ Appeal Communication to Board of Appeals and Interferences
- ☐ Appeal Communication to Group (Appeal Notice, Brief, Reply Brief)
- ☐ Proprietary Information
- ☐ Status Letter
- ☒ Additional Enclosure(s) (please identify below):

Copies of references cited  
Return postcard

Remarks

## SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm or Individual name Brent P. Johnson  
Fields & Johnson, P.C.

Signature

*Brent P. Johnson*

Date

2/16/99

## CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231 on this date: 2/16/99

Typed or printed name Brent P. Johnson

Signature

*Brent P. Johnson*

Date

2/16/99

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re the Application of

Edwin L. Adair, Jeffrey L. Adair,

Randall S. Adair

Serial No.: 09/175,685

Filed: October 20, 1998

For: "Reduced Area Imaging  
Devices"

) SUBMISSION OF  
) INFORMATION DISCLOSURE  
) CITATION

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*Katherine L. Anderson*  
Name of applicant, assignee, or Registered Prop.

Assistant Commissioner for Patents  
Washington, D.C. 20231

RECEIVED

FEB 25 1999

Sir:

Enclosed for the Examiner's consideration is an Information  
Disclosure Citation In An Application along with copies of each of the  
references cited. These references include all the references cited by the  
applicant or by the Patent Office in co-pending applications Serial Nos.  
08/944,322 and 08/976,976. This Information Disclosure Citation also  
includes two additional references which were cited in the International  
Search Report of a related PCT application, International Application No.  
PCT/US98/19379.

Respectfully submitted,

FIELDS & JOHNSON, P.C.

Gary D. Fields

Brent P. Johnson

Attorneys For Applicant

8480 East Orchard Road, Suite 5600

Englewood, CO 80111

(303) 689-9100

Date:

2/16/99

EXPRESS MAIL NO. EL146014919US

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

JCS11 U.S. PTO  
09/175685  
10/20/98

In Re the Continuation-in-Part  
Application of

) PETITION TO MAKE  
) SPECIAL UNDER  
) 37 C.F.R. §1.102

Edwin L. Adair, Jeffrey L. Adair,  
Randall S. Adair

)  
)  
)

Corresponding to  
U.S. Serial No.: 08/944,322  
Filed: October 6, 1997

)  
)  
)  
)

For: "Reduced Area Imaging Devices")

Assistant Commissioner for Patents  
Washington, D.C. 20231

PETITION TO MAKE SPECIAL


Dear Sir\Madam:

One of the Applicant hereby petitions to make the above-identified application special under 37 C.F.R. §1.102(c). According to this rule, this petition may be filed without a fee because the basis for this petition is the Applicant's age.

Attached with this Petition is Applicant's Declaration indicating that Applicant is 65 years of age, or older.

Respectfully submitted,

FIELDS & JOHNSON, P.C.



---

Gary D. Fields

Brent P. Johnson

Attorneys for Applicant

8480 East Orchard Road, Suite 5600

Englewood, CO 80111

(303) 689-9100

Date: 10/20/98



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE



In Re the Continuation in Part ) **DECLARATION UNDER**  
Application of ) **37 C.F.R. § 1.102**  
)  
Edwin L. Adair, Jeffrey L. Adair, )  
Randall S. Adair )  
)  
Corresponding to )  
U.S. Serial No. 08/944,322 )  
Filed: October 6, 1997 )  
)  
For: "Reduced Area Imaging Devices" )

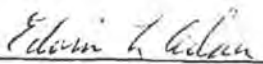
Assistant Commissioner for Patents  
Washington, D.C. 20231

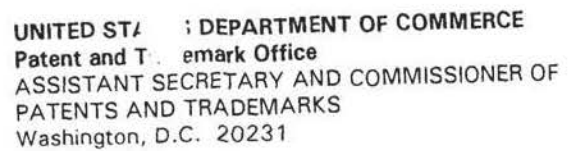
**DECLARATION OF EDWIN L. ADAIR**

I, Edwin L. Adair, hereby declare that, as of the filing date of the above-identified application, I am 65 years of age or older.

I further declare under penalty of perjury pursuant to the laws of the United States of America that the foregoing is true and correct, and that this Declaration was executed by me on 10/20, 1998.

Respectfully submitted,

  
\_\_\_\_\_  
Edwin L. Adair



Paper No.

APR 9 1999

In re application of  
Edwin L. Adair, et al.  
Application No.: 09/175,685  
Filed: October 20, 1998  
For: REDUCED AREA IMAGING  
DEVICES

## DECISION ON PETITION

If the examiner can make this application special without prejudice to any possible interfering applications, and he or she should make a rigid search for such, he or she is authorized to do so for the next action. Should the application be rejected, the application will not be



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MAR 24 1999

Please type a plus sign (+) inside this box → ☐

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Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

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<b>TRANSMITTAL FORM</b> (to be used for all correspondence after initial filing)	Application Number	09/175,685
	Filing Date	10/20/98
	First Named Inventor	Edwin L. Adair, et al.
	Group Art Unit	2713
	Examiner Name	
Total Number of Pages in This Submission	7	Attorney Docket Number F97.13 CIP2

ENCLOSURES (check all that apply)		
<input checked="" type="checkbox"/> Fee Transmittal Form	<input type="checkbox"/> Assignment Papers (for an Application)	<input type="checkbox"/> After Allowance Communication to Group
<input checked="" type="checkbox"/> Fee Attached	<input type="checkbox"/> Drawing(s)	<input type="checkbox"/> Appeal Communication to Board of Appeals and Interferences
<input checked="" type="checkbox"/> Amendment / Response - Preliminary	<input type="checkbox"/> Licensing-related Papers	<input type="checkbox"/> Appeal Communication to Group (Appeal Notice, Brief, Reply Brief)
<input type="checkbox"/> After Final	<input type="checkbox"/> Petition Routing Slip (PTO/SB/69) and Accompanying Petition	<input type="checkbox"/> Proprietary Information
<input type="checkbox"/> Affidavits/declaration(s)	<input type="checkbox"/> Petition to Convert to a Provisional Application	<input type="checkbox"/> Status Letter
<input type="checkbox"/> Extension of Time Request	<input type="checkbox"/> Power of Attorney, Revocation Change of Correspondence Address	<input type="checkbox"/> Additional Enclosure(s) (please identify below):
<input type="checkbox"/> Express Abandonment Request	<input type="checkbox"/> Terminal Disclaimer	
<input type="checkbox"/> Information Disclosure Statement	<input type="checkbox"/> Small Entity Statement	
<input type="checkbox"/> Certified Copy of Priority Document(s)	<input type="checkbox"/> Request for Refund	
<input type="checkbox"/> Response to Missing Parts/Incomplete Application	Remarks	
<input type="checkbox"/> Response to Missing Parts under 37 CFR 1.52 or 1.53		

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT	
Firm or Individual name	Brent P. Johnson Fields & Johnson, P.C.
Signature	
Date	3/8/99

CERTIFICATE OF MAILING	
I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231 on this date: 3/8/99	
Typed or printed name	Brent P. Johnson
Signature	
Date	3/8/99

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TOTAL AMOUNT OF PAYMENT (\$ ) 159.00

## Complete if Known

Application Number	09/175,685
Filing Date	10/20/98
First Named Inventor	Edwin L. Adair et al.
Examiner Name	
Group / Art Unit	2713
Attorney Docket No.	E97-13 CIP2

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Group 2700

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Deposit Account Name: Fields & Johnson, P.C.

- ☒ Charge Any Additional Fee Required Under 37 CFR 1.16 and 1.17

2. ☒ Payment Enclosed:

☒ Check ☐ Money Order ☐ Other

## FEE CALCULATION

### 1. BASIC FILING FEE

Large Entity Fee Code (\$)	Small Entity Fee Code (\$)	Fee Description	Fee Paid
101 760	201 380	Utility filing fee	
106 310	206 155	Design filing fee	
107 480	207 240	Plant filing fee	
108 760	208 380	Reissue filing fee	
114 150	214 75	Provisional filing fee	

SUBTOTAL (1) (\$ )

### 2. EXTRA CLAIM FEES

Total Claims	Extra Claims	Fee from below	Fee Paid
29	-20** = 9	9	81
Independent Claims	-3** = 2	39	78
Multiple Dependent			

\*\*or number previously paid, if greater; For Reissues, see below

Large Entity Fee Code (\$)	Small Entity Fee Code (\$)	Fee Description
103 18	203 9	Claims in excess of 20
102 78	202 39	Independent claims in excess of 3
104 260	204 130	Multiple dependent claim, if not paid
109 78	209 39	** Reissue Independent claims over original patent
110 18	210 9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) (\$ ) 159

## FEE CALCULATION (continued)

### 3. ADDITIONAL FEES

Large Entity Fee Code (\$)	Small Entity Fee Code (\$)	Fee Description	Fee Paid
105 130	205 65	Surcharge - late filing fee or oath	
127 50	227 25	Surcharge - late provisional filing fee or cover sheet	
139 130	139 130	Non-English specification	
147 2,520	147 2,520	For filing a request for reexamination	
112 920*	112 920*	Requesting publication of SIR prior to Examiner action	
113 1,840*	113 1,840*	Requesting publication of SIR after Examiner action	
115 110	215 55	Extension for reply within first month	
116 380	216 190	Extension for reply within second month	
117 870	217 435	Extension for reply within third month	
118 1,360	218 680	Extension for reply within fourth month	
128 1,850	228 925	Extension for reply within fifth month	
119 300	219 150	Notice of Appeal	
120 300	220 150	Filing a brief in support of an appeal	
121 260	221 130	Request for oral hearing	
138 1,510	138 1,510	Petition to institute a public use proceeding	
140 110	240 55	Petition to revive - unavoidable	
141 1,210	241 605	Petition to revive - unintentional	
142 1,210	242 605	Utility issue fee (or reissue)	
143 430	243 215	Design issue fee	
144 580	244 290	Plant issue fee	
122 130	122 130	Petitions to the Commissioner	
123 50	123 50	Petitions related to provisional applications	
126 240	126 240	Submission of Information Disclosure Stmt	
581 40	581 40	Recording each patent assignment per property (times number of properties)	
146 760	246 380	Filing a submission after final rejection (37 CFR 1.129(a))	
149 760	249 380	For each additional invention to be examined (37 CFR 1.129(b))	

Other fee (specify) \_\_\_\_\_

Other fee (specify) \_\_\_\_\_

\* Reduced by Basic Filing Fee Paid

SUBTOTAL (3) (\$ ) 0

## SUBMITTED BY

Typed or Printed Name: Brent P. Johnson

Signature:

Date: 3/8/99

## Complete (if applicable)

Reg. Number: 38,031

Deposit Account User ID: 06-0778

Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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17026  
4-13-99

In Re the Application of )

PRELIMINARY AMENDMENT 2 4 1999

Edwin L. Adair, Jeffrey L. Adair, )

Randall S. Adair )

Serial No.: 09/175,685 )

Filed: October 20, 1998 )

For: "Reduced Area Imaging  
Devices" )

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Assistant Commissioner for Patents, Washington,

D.C. 20231, on 3/8/99  
(Date of Deposit)

Daphne L. Gonzalez  
Name of applicant, assignee, or Registered Rep.

Group 2700

Assistant Commissioner for Patents  
Washington, D.C. 20231

Sir:

Please amend the above-identified application as follows:

IN THE CLAIMS:

Add the following new claims:

*Sub D3*

8. A reduced area imaging device, as claimed in claim 1,  
wherein said image sensor further includes:

an array of passive CMOS pixels, wherein individual passive  
CMOS pixels of said array of passive CMOS pixels each includes a photo

diode for producing photoelectrically generated signals; and

an access transistor communicating with said photo diode to  
control the release of said photoelectrically generated signals.

9. A reduced area imaging device, as claimed in claim 6,  
wherein said array of pixels includes:

a plurality of passive CMOS pixels, and wherein individual  
passive CMOS pixels of said plurality of passive CMOS pixels each

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5 includes a photo diode for producing photoelectrically generated signals;  
and

an access transistor communicating with said photo diode to  
control the release of said photoelectrically generated signals.

10. A reduced area imaging device, as claimed in claim 6,  
wherein:

individual pixels within said array of pixels each includes an  
amplifier.

B1  
cont  
Sub-D4

11. A reduced area imaging device comprising:  
an array of CMOS pixels defining a profile area and lying in  
a first plane, said array of CMOS pixels for receiving images thereon;  
a circuit board longitudinally aligned with and electrically  
5 couples to said array of CMOS pixels, said circuit board lying in a second  
plane which is offset from said first plane and substantially parallel to said  
first plane, said circuit board including circuitry means for timing and  
control of said array of CMOS pixels, said timing and control means  
producing a pre-video signal, said circuit board further including circuitry  
10 means for receiving said pre-video signal from said timing and control  
means and converting said pre-video signal to a post-video output signal  
for reception by a video device; and  
a power supply electrically coupled to said array of said  
CMOS pixels and said circuit board.

10.  
12. A reduced area imaging device, as claimed in claim 11  
wherein:



said array of CMOS pixels includes an array of passive CMOS pixels.

11, 13, A reduced area imaging device, as claimed in claim 11, 9

further including:

a supplementary circuit board communicating with said array of CMOS pixels and said circuit board for enhancing said pre-video signal, said supplementary circuit board being longitudinally aligned with said array of CMOS pixels and said circuit board, and being positioned so as not to extend substantially beyond said profile area.

A1  
cont

Sub D5

14. An endoscope with integral imaging capability comprising:  
a tubular portion including a distal end, a proximal end and a central passageway extending therethrough;  
means for providing light to said distal end to illuminate a surgical site;  
a CMOS image sensor lying in a first plane and positioned at said distal end of said tubular portion for receiving images of the surgical site, said CMOS image sensor defining a profile area, and said CMOS image sensor producing an image signal;  
circuitry means electrically coupled to said CMOS image sensor for timing and control of said CMOS image sensor, said circuitry means for timing and control placed within said tubular portion;  
a video processor board lying in a second plane spaced from and longitudinally aligned with said CMOS image sensor within said tubular portion and adjacent said distal end thereof, said video processor board including circuitry means for processing said image signal and

*D5 cancel.*

converting said image signal to a post-video signal, said video processor board being positioned so as not to extend substantially beyond said profile area, said video processor board communicating with said CMOS image sensor to receive said image signal; and

20 a power supply electrically coupled to said CMOS image sensor and said video processor board.

*13.*  
*15.* An endoscope, as claimed in claim *12* *14*, wherein:  
said CMOS image sensor includes an array of CMOS pixels,  
and wherein individual CMOS pixels within said array of CMOS pixels  
each includes an amplifier.

*A1*  
*cont*

*14.*  
*16.* An endoscope, as claimed in claim *12* *14*, wherein:  
said CMOS image sensor includes a plurality of passive  
CMOS pixels.

*15.*  
*17.* An endoscope, as claimed in claim *12* *14*, wherein:  
said CMOS image sensor includes a plurality of passive  
CMOS pixels, and wherein individual passive CMOS pixels of said  
plurality of passive CMOS pixels each includes a photo diode for  
5 producing photoelectrically generated signals, and an access transistor  
communicating with said photo diode to control the release of said  
photoelectrically generated signals.

*16.*  
*18.* An endoscope, as claimed in claim *12* *14*, wherein:  
said circuitry means for timing and control is placed on said  
10 first plane adjacent said CMOS image sensor.

<sup>17</sup>  
~~19~~ An endoscope, as claimed in claim <sup>12</sup>~~14~~, wherein:  
said circuitry means for timing and control is placed on said  
second plane adjacent said circuitry means for processing and converting.

<sup>18</sup>  
~~20~~ An endoscope, as claimed in claim <sup>12</sup>~~14~~, further including:  
a handle connected to said proximal end of said tubular  
portion for grasping by surgeon.

<sup>19</sup>  
~~21~~ An endoscope, as claimed in claim <sup>12</sup>~~14~~, further including:  
a lens positioned at said distal end of said tubular portion and  
distally of said CMOS image sensor for producing a modified image on  
said CMOS image sensor.

<sup>20</sup>  
~~22~~ An endoscope, as claimed in claim <sup>12</sup>~~14~~, wherein:  
said power supply is a battery attached to said handle.

<sup>21</sup>  
~~23~~ An endoscope, as claimed in claim <sup>12</sup>~~14~~, wherein:  
said second plane is offset from and substantially parallel to  
said first plane.

Sub C's 24. An endoscope comprising:  
a tubular portion including a central passageway extending  
therethrough, a proximal end and a distal end;  
a CMOS image sensor positioned at said distal end of said  
5 tubular portion for receiving images of a surgical site, said CMOS imager  
defined by an array of CMOS pixels wherein individual pixels within said

array of said CMOS pixels each include an amplifier, said CMOS imager lying in a first plane;

circuitry means for timing and control of said CMOS image sensor placed adjacent to said CMOS image sensor on said first plane;

a control box remote from said tubular portion and coupled to said CMOS image sensor, said control box including circuitry means for receiving a pre-video signal from said CMOS image sensor, and for converting said pre-video signal to a post-video signal which may be received by a standard video device; and

a power supply coupled to said control box and said CMOS image sensor for providing power thereto.

<sup>23</sup>  
<sup>25</sup> An endoscope, as claimed in claim <sup>22</sup>24, wherein:  
said power supply is located in said control box.

<sup>24</sup>  
<sup>26</sup> An endoscope, as claimed in claim <sup>22</sup>24, further including:  
a handle connected to said proximal end of said tubular portion for grasping by a surgeon.

<sup>25</sup>  
<sup>27</sup> An endoscope, as claimed in claim <sup>22</sup>24, further including:  
a supplementary circuit board for digitally enhancing said pre-video signal, said supplementary circuit board electrically coupled to said circuitry means for receiving and converting.

<sup>28</sup> 28. An endoscope, as claimed in claim 24, further including:

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An endoscope, as claimed in claim 24<sup>22</sup>, wherein:  
said power supply is a battery attached to said handle.

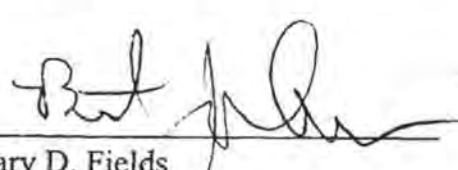
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**REMARKS**

The foregoing Claims 8-29 have been added. It is respectfully requested that these added claims be examined in conjunction with the original Claims 1-7. Enclosed herewith is a check for \$141.00 for the fees for the additional claims. Any shortfall may be charged to Deposit Account No. 06-0778.

Respectfully submitted,

FIELDS &amp; JOHNSON, P.C.

  
\_\_\_\_\_  
Gary D. Fields  
Brent P. Johnson  
8480 East Orchard Road, Suite 5600  
Englewood, CO 80111  
(303) 689-9100

Date: \_\_\_\_\_

3/8/99

Fax Received

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Group 2700

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

OFFICIAL

In Re the Application of

Edwin L. Adair, et al.

Serial No. : 09/175,685

Filed: 10/20/98

For: "Reduced Area Imaging  
Devices"

Assistant Commissioner for Patents  
Washington, D.C. 20231

Sir/Madam:

**SUPPLEMENTARY  
PRELIMINARY AMENDMENT**

Examiner: A. Rao

Art Unit: 2713

**CERTIFICATE OF FACSIMILE TRANSMISSION**

I hereby certify that this paper for reg./ser. no.

09/175,685 is being facsimile transmitted to the

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on the date shown below.

Virginia A. Sawatzke  
Type of print name of person signing certificate

Virginia A. Sawatzke 3/24/99  
Signature Date

Please further amend the above-identified application as follows:

**IN THE CLAIMS**

Add the following new claims:

SUB E7

30. A reduced area imaging device comprising:

an array of CMOS pixels defining a profile area and lying in  
a first plane, said array of said CMOS pixels for receiving images thereon;

a circuit board longitudinally aligned with and electrically

- 5 coupled to said array of CMOS pixels, said circuit board lying in a second  
plane which is offset from said first plane and substantially parallel to said  
first plane, said circuit board including timing and control means for  
controlling the release of information from said array of CMOS pixels, said  
timing and control means producing a pre-video signal;

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cont

2

10 a control box remote from said array of said CMOS pixels  
and said circuit board, said control box including circuitry means for  
receiving said pre-video signal, and for converting said pre-video signal to  
a post-video signal which may be received by a standard video device; and  
a power supply coupled to said control box, said array of  
15 CMOS pixels and said timing and control means for providing power  
thereto.

<sup>27</sup>  
~~31~~ A reduced area imaging device, as claimed in claim <sup>28</sup>~~30~~,  
wherein said array of CMOS pixels further includes:

*B1*  
*control*  
5 an array of passive CMOS pixels, wherein individual passive  
CMOS pixels of said array of passive CMOS pixels each includes a photo  
diode for producing photoelectrically generated signals; and  
an access transistor communicating with said photo diode to  
control the release of said photoelectrically generated signals.

<sup>30</sup>  
~~32~~ A reduced area imaging device, as claimed in claim <sup>28</sup>~~30~~,  
wherein said array of CMOS pixels further includes:  
an array of active CMOS pixels, wherein individual active  
CMOS pixels within said array of active CMOS pixels each includes an  
5 amplifier.

### REMARKS

The foregoing Claims 30 through 32 have been added. It is respectfully that these added claims be examined in conjunction with original Claims 1-7, and Claims 8-29 added in the first Preliminary Amendment. Enclosed herewith is a check for \$57.00 to cover the fees for

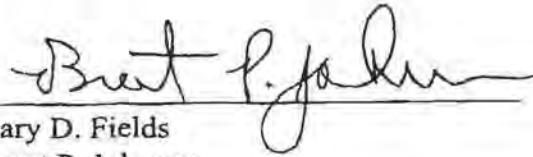


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these additional claims. Any shortfall may be charged to Deposit Account  
No. 06-0778.

Respectfully submitted,

FIELDS & JOHNSON, P.C.



Gary D. Fields  
Brent P. Johnson  
Attorneys for Applicant  
8480 East Orchard Avenue, Suite 5600  
Englewood, CO 80111  
(303) 689-9100

Date: 3/24/99



GP 2713

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

#7  
ROSE  
4-13-99

In Re the Application of )  
)  
Edwin L. Adair, Jeffrey L. Adair, )  
Randall S. Adair )  
)  
Serial No.: 09/175,685 )  
)  
Filed: October 20, 1998 )  
)  
For: "Reduced Area Imaging )  
Devices"

**SUBMISSION OF DECLARATIONS**  
**UNDER 37 C.F.R. §1.132**

Examiner: A. Rao

Art Unit: 2713

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D.C. 20231, on 4/1/99

*Katherine L. Gonzalez*  
(Date of Deposit)  
Name of applicant, assignee, or Registered Rep.

Assistant Commissioner for Patents  
Washington, D.C. 20231

Dear Sir:

Enclosed are two Declarations Under 37 C.F.R. §1.132. It is respectfully  
requested that the Examiner consider these Declarations in conjunction with the  
examination of the above-identified application.

Respectfully submitted,

FIELDS & JOHNSON, P.C.

*Brent P. Johnson*

Gary D. Fields  
Brent P. Johnson  
8480 East Orchard Road, Suite 5600  
Englewood, CO 80111  
(303) 689-9100

Date: 4/1/99

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re the Application of ) **DECLARATION UNDER 37 C.F.R.**  
 ) **§1.132**  
Edwin L. Adair, Jeffrey L. Adair, )  
Randall S. Adair ) Examiner: A. Rao  
 )  
Serial No.: 09/175,685 ) Art Unit: 2713  
 )  
Filed: October 20, 1998 )  
 )  
For: "Reduced Area Imaging )  
Devices" )

Assistant Commissioner for Patents  
Washington, D.C. 20231



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I, Jeffrey L. Adair, declare as follows:

1. I am Chief Engineer of Medical Dynamics, Inc. I am responsible for the design and manufacture of medical camera systems and peripheral components such as light sources, insufflators, etc. I am also responsible for overseeing the transition from prototype development to full production of said camera systems and peripherals. I am also responsible for assisting in prototype development which includes being present during medical procedures conducted in a hospital when our devices are being tested by a surgeon.

2. I received an Associate of Applied Sciences degree in Electrical Engineering from Denver Technical University in 1985.

3. I have held the position of Chief Engineer at Medical Dynamics, Inc. since 1987. During that time, I have headed up design teams which have produced more the 45 different types of surgical cameras including 17 models of electronic video laparoscopes in which CCD devices were placed at the distal ends of such

laparoscopes. All of these devices have been commercially successful for Medical Dynamics, Inc.

4. As a result in my experience in designing electronic endoscopes, I have extensively studied and researched CCD technology and I am very familiar with all aspects of CCD cameras.

5. I have closely followed the emergence of new CMOS imagers and I have tested several CMOS imagers from various manufacturers over the past two years. Medical Dynamics, Inc. has documented several well-known advantages which CMOS imagers have over CCD image devices such as low power consumption, lower production/manufacture costs, and a high level of on-chip circuit integration in comparison to CCD imagers.

6. As a co-inventor, I have read and am familiar with the above-identified patent application, and the invention described and claimed therein. I have also read and am familiar with the new claims appearing in the Preliminary Amendment dated March 8, 1999 and the Supplemental Preliminary Amendment dated March 24, 1999.

7. Prior to my development of the above-identified invention, I was aware of no other person or entity who had developed an imaging device or endoscope which utilized a CMOS pixel array with timing control circuitry placed together on one plane or circuit board, and remaining processing circuitry either placed in a remote control box, or on other circuit boards placed closely adjacent the CMOS pixel array.

8. There has been great skepticism in the industry as to the capability to use CMOS technology in medical imaging applications. CMOS imagers have been characterized as not being capable of producing high quality images. Despite

this skepticism, we were able to locate companies developing CMOS technology that might be usable within an imaging device configured as described in Paragraph 7 above.

9. After extensive testing, we were able to develop an imaging device which produced an extremely high quality image, was of incredibly small size, yet maintained the well-known advantages of CMOS imagers.

10. During our testing of the devices claimed in this invention, we discovered an unknown, but very important advantage that our device has over CCD imagers. This advantage is the capability of our device to reject radio frequency interference (RFI) which is emitted by electrosurgical generators used during surgery. In many surgical procedures, an endoscope is used in order to view the surgical area while another device, such as an electrosurgical generator, is used to actually manipulate (*i.e.*, cut or cauterize) the tissue.

11. CCD devices cannot be used near an electrical surgical generator without requiring significant shielding for the CCD device. Such shielding requires intense grounding techniques for the CCD camera cables/conductors which trail the CCD imager, and also grounding for the actual CCD pixel array. These shielding techniques not only add significantly to the size of the CCD device, but also to the overall cost of the CCD camera system. Even when such shielding is incorporated, RFI levels are only brought to a reasonable level which may still result in an obstructed view of the surgical area.

12. After testing several types of CMOS configurations, we concluded that remoting the processing circuitry from the CMOS imager and timing and control circuits eliminated the need for shielding. In other words, we found that this configuration was not susceptible to RFI. Such an unexpected result allowed

us to consider even smaller diameter endoscopes which can be used directly with the electrosurgical generators. This remoting feature can be achieved by removing the processing circuitry from the same circuit board or plane as the pixel array and then placing the processing circuitry in either a remote box/unit or on another circuit board adjacent and spaced from the pixel array.

13. This feature of remoting the processing circuitry is recited in all of the independent claims.

14. Even with standard CMOS devices which have processing circuitry on chip with the CMOS pixel array, at least some shielding is required to prevent RFI in order to optimize the image. Thus, our efforts in redesigning certain CMOS technologies still produced the unexpected result of RFI rejection.

15. Independent Claims 1, 6, and 24 claim this particular feature of the invention wherein processing circuitry is remoted from a co-planar pixel array and timing and control circuitry.

16. In addition to the configuration in which the pixel array and the timing and control circuit is placed on a single plane, we also observed the same advantageous results with respect to RFI rejection when we placed the CMOS pixel array by itself on one plane, and connected the timing and control circuitry to the pixel array on a second plane spaced from the pixel array. In this configuration, the processing circuitry was also remoted in either a remote control box or on circuit boards separated from, but adjacent to the pixel array. This particular feature is specifically claimed in Claim 30.

17. I have also read and understand the following prior art references which are cited in this application:

- A. "Imaging Options Expand With CMOS Technology", *Laser Focus World*, June 1997;
- B. "NASA's Tiny Camera Has a Wide-Angle Future", *Business Week*, March 6, 1995;
- C. U.S. Patent No. 5, 754,313 to Pelchy, et al.; and
- D. U.S. Patent No. 5,471,515 to Fossum, et al.

18. In my review of Pelchy, et al., I see no applicability of this patent disclosure with regard to the imaging device claimed in this invention. Pelchy is directed to an improvement wherein tape automated bonding (TAB) is used to connect timing and control circuitry for a CCD imager.

19. Pelchy, et al., column 1, lines 7-11, states: "The increased availability of smaller solid state imagers based on CCD or CMOS technologies has surpassed the ability of conventional wire bonding techniques to take full advantage of the space savings afforded by these small imagers." This general statement may be true; however, I find no discussion or disclosure within this reference as to how TAB is advantageous for the imaging device and endoscopes claimed in our application. When timing and control circuitry is placed co-planar with the CMOS pixel array as claimed Claims 1, 6 and 24, the TAB shown in Pelchy is absolutely not needed. As disclosed in the description of my invention, there are only three imager leads which are required to interconnect the processing circuitry to the pixel array and timing and control circuits. These leads exit from the plane of the CMOS pixel array through the back side and well within the edges of the CMOS pixel array. Pelchy, on the other hand, requires that the leads be connected at the edge or periphery of the imaging plane which results in the imaging device having a larger profile. Additionally, because the leads are



exposed in this manner, they require reinforcement in the form of protective strips which are shown in Pelchy as protective strips 31. Because of the type of TAB being disclosed in Pelchy, I believe that this reference actually teaches away from any combination with attributes of a CMOS imager. Thus, the type of TAB disclosed in this reference has no advantage or applicability to any CMOS device I have ever known.

20. The other references mentioned above all discuss a CMOS-based imager or hybrid imager wherein all of the imaging elements or components are found on the same plane. In short, these other references describe what are becoming known as "cameras on a chip." I find no suggestions in these references that these types of imagers should be split up in various configurations to include processing circuitry remoted from a co-planar pixel array and timing and control circuits, or even that the timing and control circuits should be remoted from the pixel array. This would obviously detract from the "camera on a chip" concept if the circuitry were split up.

21. Based on the foregoing, I believe that the invention has satisfied a long felt need to provide an imaging device which is of a minimum profile, is readily compatible with the electrosurgical generators, and still provides the other well-known advantages of CMOS imagers over CCD imagers.

I declare that all statements made on information contained of my own knowledge are true, and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine

or imprisonment or both under Section 1001 of Title 18 of United States Code, and that such willful false statements may jeopardize the validity of this document.

Dated this 31 day of MARCH, 1999.

  
\_\_\_\_\_  
Jeffrey L. Adair



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re the Application of	)	<u><b>DECLARATION UNDER 37 C.F.R.</b></u>
	)	<u><b>§1.132</b></u>
Edwin L. Adair, Jeffrey L. Adair,	)	
Randall S. Adair	)	Examiner: A. Rao
	)	
Serial No.: 09/175,685	)	Art Unit: 2713
	)	
Filed: October 20, 1998	)	
	)	
For: "Reduced Area Imaging	)	
Devices"	)	

Assistant Commissioner for Patents  
Washington, D.C. 20231

I, Jack Baird, Ph.D., declare as follows:

1. I received my Bachelor of Science (1958), a Master of Science (1959), and my Doctorate degree (1963) from the University of Illinois, Urbana, Illinois.
2. From 1963-1967 I was a full Professor in the electrical engineering department at the University of Illinois.
3. From 1967-1981, I was a full Professor and Associate Department Chairman of the electrical engineering department at the University of Colorado, Boulder, Colorado.
4. From 1981-1988, I was the President and Chief Engineer for LED Systems, Inc. As President and Chief Engineer, my technical responsibilities included research and development, design and testing of electronic equipment and systems.

5. From 1988-1998, I was President and Chief Engineer of Video Accessory Corporation. As President and Chief Engineer, my technical responsibilities also included research and development, design and testing of electronic equipment and systems.

6. Since 1998, I have been retired, but continue with consulting work in the electrical engineering field.

7. I have read and I am familiar with the above-identified patent application and the invention described and claimed therein by the inventors. I have also read and am familiar with the new claims appearing in the Preliminary Amendment dated March 8, 1999 and the Supplemental Preliminary Amendment dated March 24, 1999.

8. As a result of my experience, I am knowledgeable regarding existing imaging technology to include standard CCD, CMOS and emerging hybrid type imagers.

9. I have also read and understand the following prior art references which are made of record in this application:

A. "Imaging Options Expand With CMOS Technology", *Laser Focus World*, June 1997;

B. "NASA's Tiny Camera Has A Wide Angle Future", *Business Week*, March 6, 1995;

C. U.S. Patent No. 5,754,313 to Pelchy, et al.; and

D. U.S. Patent No. 5,471,515 to Fossum, et al.

10. *Business Week's* article is correct in explaining why standard CCD technology is impractical for making a reasonably small CCD imaging device with all imaging elements on a single plane.

11. Fossum, et al. appears to have overcome this problem with a new imaging technology which may be found on a relatively small chip, and which previously required multiple chips of much larger size.

12. I agree with the *Business Week* article and the Fossum, et al. patent which state that on-chip processing is impractical with standard CCD technology, particularly for imagers in the medical field which must be kept at a minimum size. In fact, the CCD process is so unique that it simply is not possible to put timing and control circuits co-planar with the pixel array.

13. Pelchy, et al. is directed to an imager which is made shorter in length as compared to the prior art. This reduced length requires tape automated bonding (TAB) to connect the image sensor to the timing and control circuitry. I believe that Pelchy is simply representative of standard CCD technology which requires timing and control circuitry to be closely situated, but remote from the pixel array in order to minimize size and interference. Because of the size of timing and control circuitry required for standard CCD imaging devices and interference problems, standard CCD imaging devices simply do not have such circuitry placed co-planar with the pixel array. Furthermore, processing circuitry is required to be remote from the distal tip of a CCD imaging device because such circuitry is so large and bulky.

14. Although Pelchy, et al. is silent as to the specific type of circuitry found on the circuit boards placed perpendicular to the pixel array, I believe that this circuitry can be no other than that of the timing and control circuitry of a standard CCD device. Pelchy, et al. illustrates a large number of transmission wires 33 which interconnect the circuit boards placed perpendicular to the pixel array with an external processor 13. Specifically, there are twelve conductors

which are shown to interconnect the external processor 13 to the circuit boards 27 and 28. It would be clearly undesirable for a CMOS imager to incorporate the configuration shown in Pelchy, et al. wherein there are a large number of transmission wires because CMOS imagers can transmit a pre-video signal to some external processor with only three conductors. This three conductor configuration greatly simplifies shielding efforts to prevent radio frequency interference (RFI). Thus, based upon the disclosure of Pelchy, et al., I find that Pelchy is clearly directed to a standard CCD imaging device and overcoming the problems with CCD devices.

15. Since the timing and control circuitry for CMOS imagers is so small in comparison to timing and control circuitry for CCD devices, timing and control circuitry can be placed co-planar with the CMOS pixel array without adding any significant size to the overall imager profile. Even if it is desired to remote the timing and control circuitry from the CMOS pixel array, the TAB process in Pelchy, et al. is inefficient and undesirable. Much fewer leads or transmission wires are needed in CMOS and such leads or transmission wires can be in the form of pins attached within the edges of the adjacent circuit boards. This feature of the applicant's invention is shown in Figure 2b. Pelchy requires bonding to the edges or periphery of the imager which adds size to the imager profile. The exposure of the transmission wires at the edges also requires additional support, which is shown in Pelchy as protective strips 31. No extra support is needed for the pins disclosed in Figure 2b

16. Therefore, it is my belief that the TAB process disclosed in this Pelchy, et al. reference is only applicable and advantageous with respect to

standard CCD imagers and actually teaches away from any use with CMOS technology.

17. Pelchy at column 1, lines 7-11 reads "The increased availability of smaller solid state imagers based on CCD or CMOS technologies has surpassed the ability of conventional wire bonding techniques to take full advantage of the space savings afforded by these small imagers." This general statement may be factually correct; however, the TAB process actually disclosed in this patent is not needed for CMOS and clearly detracts from the advantages of CMOS if such a TAB process were used. Therefore, this statement cannot be interpreted as meaning that the TAB process of Pelchy has any applicability to or lends itself for use with a CMOS imager of the type claimed in this application.

18. On the other hand, if a CMOS imager of the type disclosed in the *Business Week* article or the Fossum, et al. patent were substituted with the imager of Pelchy, this would defeat the need for TAB in the first place, because the timing and control circuitry of CMOS is so small that it does not materially affect the size of the imaging plane.

19. I find no indication or suggestion in any of the prior art references discussed above of providing a CMOS imager which has timing and control circuitry placed on the same plane while other remaining circuitry is either remotored in a control box or placed on other circuit boards adjacent and spaced from the co-planar CMOS imager and timing and control circuitry.

20. My comments above specifically apply to independent Claims 1, 6 and 24 which claim co-planar imaging and timing and control elements.

21. I understand that the invention according to Claims 1, 6 and 24 does not require any type of shielding in order to avoid RFI effects. I believe that this is



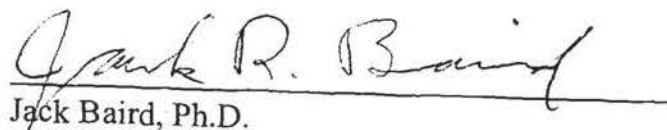
an unexpected and advantageous result which is not generally known in my field of expertise. Typically, great efforts are required to protect a device from RFI, particularly for CCD devices, and at least some shielding is required for CMOS devices.

22. In addition to the claimed configuration in which the pixel array and timing and control circuitry is placed on a single plane, it is my understanding that advantageous results with respect to RFI rejection were achieved when the pixel array was placed by itself on one plane or structure, and timing and control circuitry was connected to the pixel array from a second plane spaced from the pixel array. This particular feature is specifically claimed in claim 30. I also believe that this is an unexpected and advantageous result which is not generally known in my field of expertise.

23. I also believe that the claimed invention responds to a long felt need in the industry to provide any type of imaging device which is of a minimum size, and can produce an image which is of high quality.

I declare that all statements made on information contained of my own knowledge are true, and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both under Section 1001 of Title 18 of United States Code, and that such willful false statements may jeopardize the validity of this document.

Dated this 31 day of March, 1999.

  
Jack Baird, Ph.D.



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

RECEIVED

MAY 3 - 1999

Group 2700

In Re the Continuation in Part ) SUBMISSION OF  
Application of ) SUPPLEMENTAL  
 ) INFORMATION DISCLOSURE  
Edwin L. Adair, Jeffrey L. Adair, ) CITATION  
Randall S. Adair )  
 )  
Serial No.: 09/175,685 )  
 )  
Filed: October 20, 1998 )  
 )  
For: "Reduced Area Imaging )  
Devices"

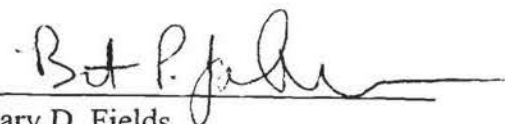
Assistant Commissioner for Patents  
Washington, D.C. 20231

Sir:

Enclosed is a Supplemental Information Disclosure Citation. This Citation is being submitted in accordance with 37 C.F.R. §1.97(b)(3). It is respectfully requested that the Examiner consider this additional reference in the examination of this application.

Respectfully submitted,

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Date: 4/22/99



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
097175,685	10/20/98	ADAIR E	F97.13-CIP2

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EXAMINER
RAO, A

ART UNIT	PAPER NUMBER
2713	9

DATE MAILED: 08/06/99

**Please find below and/or attached an Office communication concerning this application or proceeding.**

Commissioner of Patents and Trademarks

# Office Action Summary

Application No.

09/175,685

Applicant

Adair et al.

Examiner

Anand Rao

Group Art Unit

2713

☐ Responsive to communication(s) filed on \_\_\_\_\_.

☐ This action is FINAL.

☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

A shortened statutory period for response to this action is set to expire 3 month(s), or thirty days, whichever is longer, from the mailing date of this communication. Failure to respond within the period for response will cause the application to become abandoned. (35 U.S.C. § 133). Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

## Disposition of Claims

☒ Claim(s) 1-32 is/are pending in the application.

Of the above, claim(s) \_\_\_\_\_ is/are withdrawn from consideration.

☐ Claim(s) \_\_\_\_\_ is/are allowed.

☒ Claim(s) 1-27 and 29-32 is/are rejected.

☒ Claim(s) 28 is/are objected to.

☐ Claims \_\_\_\_\_ are subject to restriction or election requirement.

## Application Papers

☒ See the attached Notice of Draftsperson's Patent Drawing Review, PTO-948.

☐ The drawing(s) filed on \_\_\_\_\_ is/are objected to by the Examiner.

☐ The proposed drawing correction, filed on \_\_\_\_\_ is ☐ approved ☐ disapproved.

☐ The specification is objected to by the Examiner.

☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. § 119

☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

☐ All ☐ Some\* ☐ None of the CERTIFIED copies of the priority documents have been received.

☐ received in Application No. (Series Code/Serial Number) \_\_\_\_\_.

☐ received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

\*Certified copies not received: \_\_\_\_\_

☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

## Attachment(s)

☐ Notice of References Cited, PTO-892

☒ Information Disclosure Statement(s), PTO-1449, Paper No(s). 2 and 8

☐ Interview Summary, PTO-413

☒ Notice of Draftsperson's Patent Drawing Review, PTO-948

☐ Notice of Informal Patent Application, PTO-152

--- SEE OFFICE ACTION ON THE FOLLOWING PAGES ---

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## **DETAILED ACTION**

### *Response to Amendment*

1. As per the Applicant's instructions filed in Paper 5 on 3/11/99 and in Paper 6 on 3/25/99, claims 8-32 have been canceled.

### *Specification*

2. The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

### *Claim Objections*

3. Claim 28 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form.

A). Claim 28, line 1, it is unclear what claim 28 "further includes"....

Correction is necessary.

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*Claim Rejections - 35 USC § 103*

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 1-3, and 6-10, 14-21, and 24-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pelchy et al. (hereinafter referred to as "Pelchy") in view of the 6/97 Laser Focus article entitled "Imaging options expand with CMOS technology" (hereinafter referred to as "Laser Focus").

Pelchy discloses a reduced area imaging device (Pelchy: figure 4), comprising : an image sensor lying in a first plane and including an array of pixels for receiving images thereon, said image sensor producing a pre-video signal; (Pelchy: column 3, lines 45-50; column 1, lines 8-10), a pre-video conductor for transmitting said pre-video signal from said first circuit board to a second circuit board (Pelchy: column 4, lines 5-17); a first circuit board lying in second plane and longitudinally aligned with said image sensor, said first circuit board being connected to said pre-video conductor at said second end thereof, said first circuit board including circuitry means for converting said pre-video signal to a post-video signal for reception by a stand video device signal for reception by a standard video device (Pelchy: column 3, lines 10-15 and 54-65); and a power supply device coupled with said image sensor for driving said array of pixels, and electrically coupled to said first circuit board for driving said circuit board (Pelchy: column 4, lines 17-25),

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as specified in claim 1. However, Pelchy fails to disclose the that the image sensor further includes timing and control circuitry means on said first plane and coupled to said pixel array such as a CMOS imager (Pelchy: column 3, lines 45-50), even though the reference recognizes that the use of a TAB imager could be also apply CMOS based imager (Pelchy: column 1, lines 7-10). The Laser Focus article discloses that the use of a passive CMOS image sensor timing and control circuitry at each CMOS pixel (Laser Focus: third page, right most column, lines 32-60) is preferable to using a CCD because the standard CCD imagers as contained by the original Pelchy endoscope waste more power (Laser Focus: second page, leftmost column, lines 35-50). Accordingly, given the Laser Focus article's teaching of advantageously using a passive CMOS image sensor, it would have been obvious for one of ordinary skill in the art to modify the Pelchy apparatus by incorporating the Laser Focus article's disclosed passive CMOS imager for the standard Pelchy imager (Pelchy: figure 2, element 20) in order to minimize power consumption. The Pelchy apparatus, as modified with the inclusion of the Laser Focus's passive CMOS imager which has timing and control circuitry at each pixel site, has all of the features of claim 1.

Regarding claim 2, the Pelchy apparatus, as modified with the inclusion of the Laser Focus's passive CMOS imager which has timing and control circuitry at each pixel site, would have the image sensor defining a profile area (Pelchy: figure 2, element 21: defining profile area), and said first circuit board being positioned not to extend beyond said profile area (Pelchy: figure 2, element 28), as specified.



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Regarding claim 3, the Pelchy apparatus, as modified with the inclusion of the Laser Focus's passive CMOS imager which has timing and control circuitry at each pixel site, has a second circuit board electronically coupled with said first circuit board and said image sensor for enhancing said pre-video signal as specified, and second circuit board being longitudinally aligned with said first circuit board and said image sensor so as to not extend substantially beyond said profile area (Pelchy: figure 2, element 27), as specified.

Regarding claim 8, the Pelchy apparatus, as modified with the inclusion of the Laser Focus's passive CMOS imager which has timing and control circuitry at each pixel site, has an array of passive CMOS pixels which includes a photo diode and access transistor pair (Laser Focus: page 3, rightmost column, lines 28-38), as specified.

Pelchy discloses a reduced area imaging device (Pelchy: figure 4), comprising : an image sensor lying in a first plane and including an array of pixels for receiving images thereon, said image sensor producing a pre-video signal; (Pelchy: column 3, lines 45-50; column 1, lines 8-10), a pre-video conductor for transmitting said pre-video signal from said first circuit board to a second circuit board (Pelchy: column 4, lines 5-17); a control box remote from said image sensor, said control box including circuitry means for receiving said pre-video signal from the image sensor as specified (Pelchy: column 3, lines 10-15); and a power supply device coupled with said image sensor for driving said array of pixels, and electrically coupled to said first circuit board for driving said circuit board (Pelchy: column 4, lines 17-25), as specified in claim 6. However, Pelchy fails to disclose the that the image sensor further includes timing and control circuitry

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means on said first plane and coupled to said pixel array such as a CMOS imager (Pelchy: column 3, lines 45-50), even though the reference recognizes that the use of a TAB imager could be also apply CMOS based imager (Pelchy: column 1, lines 7-10). The Laser Focus article discloses that the use of a passive CMOS image sensor timing and control circuitry at each CMOS pixel (Laser Focus: third page, right most column, lines 32-60) is preferable to using a CCD because the standard CCD imagers as contained by the original Pelchy endoscope waste more power (Laser Focus: second page, leftmost column, lines 35-50). Accordingly, given the Laser Focus article's teaching of advantageously using a passive CMOS image sensor, it would have been obvious for one of ordinary skill in the art to modify the Pelchy apparatus by incorporating the Laser Focus article's disclosed passive CMOS imager for the standard Pelchy imager (Pelchy: figure 2, element 20) in order to minimize power consumption. The Pelchy apparatus, as modified with the inclusion of the Laser Focus's passive CMOS imager which has timing and control circuitry at each pixel site, has all of the features of claim 6.

Regarding claim 7, the Pelchy apparatus, as modified with the inclusion of the Laser Focus's passive CMOS imager which has timing and control circuitry at each pixel site, has a supplementary circuit board electronically coupled with said first circuit board and said image sensor for enhancing said pre-video signal as specified (Pelchy: figure 2, element 27), as specified.

Regarding claim 9, the Pelchy apparatus, as modified with the inclusion of the Laser Focus's passive CMOS imager which has timing and control circuitry at each pixel site, has an

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array of passive CMOS pixels which includes a photo diode and access transistor pair (Laser Focus: page 3, rightmost column, lines 28-38), as specified.

Pelchy discloses a reduced area imaging device (Pelchy: figure 4), comprising : an image sensor lying in a first plane and including an array of pixels for receiving images thereon, said image sensor producing a pre-video signal; (Pelchy: column 3, lines 45-50; column 1, lines 8-10), a pre-video conductor for transmitting said pre-video signal from said first circuit board to a second circuit board (Pelchy: column 4, lines 5-17); a control box remote from said image sensor, said control box including circuitry means for receiving said pre-video signal from the image sensor as specified (Pelchy: column 3, lines 10-15); and a power supply device coupled with said image sensor for driving said array of pixels, and electrically coupled to said first circuit board for driving said circuit board (Pelchy: column 4, lines 17-25), as specified in claim 6. However, Pelchy fails to disclose the that the image sensor further includes timing and control circuitry means on said first plane and coupled to said pixel array such as a CMOS imager (Pelchy: column 3, lines 45-50), even though the reference recognizes that the use of a TAB imager could be also apply CMOS based imager (Pelchy: column 1, lines 7-10). The Laser Focus article discloses that the use of a active CMOS image sensor timing and control circuitry at each CMOS pixel (Laser Focus: second page, rightmost column, lines 4-8) is preferable to using a CCD because the standard CCD imagers as contained by the original Pelchy endoscope waste more power (Laser Focus: second page, leftmost column, lines 35-50). Accordingly, given the Laser Focus article's teaching of advantageously using a active CMOS image sensor, it would have been obvious for

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one of ordinary skill in the art to modify the Pelchy apparatus by incorporating the Laser Focus article's disclosed active CMOS imager for the standard Pelchy imager (Pelchy: figure 2, element 20) in order to minimize power consumption. The Pelchy apparatus, as modified with the inclusion of the Laser Focus's active CMOS imager which has timing and control circuitry at each pixel site, has all of the features of claim 6.

Regarding claim 10, the Pelchy apparatus, as modified with the inclusion of the Laser Focus's active CMOS imager which has timing and control circuitry at each pixel site, has an amplifier for each individual pixel (Laser Focus: page 2, rightmost column, lines 4-9), as in the claim.

Pelchy an endoscope with integral imaging capability (Pelchy: figure 4), comprising: a tubular portion including a distal end, a proximal end, and a central passageway extending therethrough (Pelchy: column 3, lines 25-30; column 4, lines 55-60); means for providing light to said distal end to illuminate a surgical site (Pelchy: column 5, lines 5-10); an image sensor lying in a first plane and positioned at said distal end of said tubular portion for receiving images of the surgical site thereon, said image sensor defining a profile area (Pelchy: figure 2, element 21: profile area established by the circumference of element 21), said image sensor producing a pre-video signal (Pelchy: column 3, lines 45-50; column 1, lines 8-10); a video processor board lying in a second plane spaced apart from and longitudinally aligned with said image sensor within said tubular portion and adjacent said distal end thereof, said video processor board including circuitry for processing said image signal as specified, said video processing board being positioned so as

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not extend substantially beyond said profile area, as specified (Pelchy: column 3, lines 10-15 and 53-55); and a power supply device coupled with said image sensor for driving said array of pixels, and electrically coupled to said first circuit board for driving said circuit board (Pelchy: column 4, lines 17-25), as specified in claim 14. However, Pelchy fails to disclose the that the image sensor is a CMOS image and further includes timing and control circuitry means thereon, even though the reference recognizes that the use of a TAB imager could be also apply CMOS based imager (Pelchy: column 1, lines 7-10). The Laser Focus article discloses that the use of a active CMOS image sensor timing and control circuitry at each CMOS pixel (Laser Focus: second page, rightmost column, lines 4-8) is preferable to using a CCD because the standard CCD imagers as contained by the original Pelchy endoscope waste more power (Laser Focus: second page, leftmost column, lines 35-50). Accordingly, given the Laser Focus article's teaching of advantageously using a active CMOS image sensor, it would have been obvious for one of ordinary skill in the art to modify the Pelchy apparatus by incorporating the Laser Focus article's disclosed active CMOS imager for the standard Pelchy imager (Pelchy: figure 2, element 20) in order to minimize power consumption. The Pelchy apparatus, as modified with the inclusion of the Laser Focus's active CMOS imager which has timing and control circuitry at each pixel site, has all of the features of claim 14.

Regarding claim 15, the Pelchy apparatus, as modified with the inclusion of the Laser Focus's active CMOS imager which has timing and control circuitry at each pixel site, has an

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amplifier for each individual pixel (Laser Focus: second page, rightmost column, lines 4-9), as in the claim.

Pelchy an endoscope with integral imaging capability (Pelchy: figure 4), comprising: a tubular portion including a distal end, a proximal end, and a central passageway extending therethrough (Pelchy: column 3, lines 25-30; column 4, lines 55-60); means for providing light to said distal end to illuminate a surgical site (Pelchy: column 5, lines 5-10); an image sensor lying in a first plane and positioned at said distal end of said tubular portion for receiving images of the surgical site thereon, said image sensor defining a profile area (Pelchy: figure 2, element 21: profile area established by the circumference of element 21), said image sensor producing a pre-video signal (Pelchy: column 3, lines 45-50; column 1, lines 8-10); a video processor board lying in a second plane spaced apart from and longitudinally aligned with said image sensor within said tubular portion and adjacent said distal end thereof, said video processor board including circuitry for processing said image signal as specified, said video processing board being positioned so as not extend substantially beyond said profile area, as specified (Pelchy: column 3, lines 10-15 and 53-55); and a power supply device coupled with said image sensor for driving said array of pixels, and electrically coupled to said first circuit board for driving said circuit board (Pelchy: column 4, lines 17-25), as specified in claim 14. The Laser Focus article discloses that the use of a passive CMOS image sensor timing and control circuitry at each CMOS pixel (Laser Focus: third page, right most column, lines 32-60) is preferable to using a CCD because the standard CCD imagers as contained by the original Pelchy endoscope waste more power (Laser Focus: second



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page, leftmost column, lines 35-50). Accordingly, given the Laser Focus article's teaching of advantageously using a passive CMOS image sensor, it would have been obvious for one of ordinary skill in the art to modify the Pelchy apparatus by incorporating the Laser Focus article's disclosed passive CMOS imager for the standard Pelchy imager (Pelchy: figure 2, element 20) in order to minimize power consumption. The Pelchy apparatus, as modified with the inclusion of the Laser Focus's passive CMOS imager which has timing and control circuitry at each pixel site, has all of the features of claim 14.

Regarding claims 16-17, the Pelchy apparatus, as modified with the inclusion of the Laser Focus's passive CMOS imager which has timing and control circuitry at each pixel site, has an array of passive CMOS pixels which includes a photo diode and access transistor pair (Laser Focus: third page, rightmost column, lines 28-38), as specified.

Regarding claims 18-19, the Pelchy apparatus, as modified with the inclusion of the Laser Focus's passive CMOS imager which has timing and control circuitry at each pixel site, has the timing and control circuitry placed on said first plane (Laser Focus: first page, rightmost column, lines 3-13) or wherein said timing and control circuitry means for processing and converting (Pelchy: column 4, lines 15-25), as in the claims.

Regarding claim 20, the Pelchy apparatus, as modified with the inclusion of the Laser Focus's passive CMOS imager which has timing and control circuitry at each pixel site, has an endoscope with a gripping handle (Pelchy: column 3, lines 15-18: "steering capability"), as in the claim.



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Regarding claim 21, the Pelchy apparatus, as modified with the inclusion of the Laser Focus's passive CMOS imager which has timing and control circuitry at each pixel site, has a lens positioned at said distal end (Pelchy: column 5, lines 1-4), as specified.

Pelchy an endoscope (Pelchy: figure 4), comprising: a tubular portion including a distal end, a proximal end, and a central passageway extending therethrough (Pelchy: column 3, lines 25-30; column 4, lines 55-60); an image sensor lying in a first plane and positioned at said distal end of said tubular portion for receiving images of the surgical site thereon, said image sensor defining a profile area (Pelchy: figure 2, element 21: profile area established by the circumference of element 21), said image sensor producing a pre-video signal (Pelchy: column 3, lines 45-50; column 1, lines 8-10); a control box remote from said image sensor, said control box including circuitry means for receiving said pre-video signal from the image sensor as specified (Pelchy: column 3, lines 10-15); and a power supply device coupled with said image sensor for driving said array of pixels, and electrically coupled to said first circuit board for driving said circuit board (Pelchy: column 4, lines 17-25), as specified in claim 24. The Laser Focus article discloses that the use of a passive CMOS image sensor timing and control circuitry at each CMOS pixel (Laser Focus: third page, right most column, lines 32-60) is preferable to using a CCD because the standard CCD imagers as contained by the original Pelchy endoscope waste more power (Laser Focus: second page, leftmost column, lines 35-50). Accordingly, given the Laser Focus article's teaching of advantageously using a passive CMOS image sensor, it would have been obvious for one of ordinary skill in the art to modify the Pelchy apparatus by incorporating the Laser Focus

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article's disclosed passive CMOS imager for the standard Pelchy imager (Pelchy: figure 2, element 20) in order to minimize power consumption. The Pelchy apparatus, as modified with the inclusion of the Laser Focus's passive CMOS imager which has timing and control circuitry at each pixel site, has all of the features of claim 24.

Regarding claim 25, Pelchy apparatus, as modified with the inclusion of the Laser Focus's passive CMOS imager which has timing and control circuitry at each pixel site, has a power supply located in said control box (Pelchy: column 3, lines 5-16), as in claim 25.

Regarding claim 26, the Pelchy apparatus, as modified with the inclusion of the Laser Focus's passive CMOS imager which has timing and control circuitry at each pixel site, has an endoscope with a gripping handle (Pelchy: column 3, lines 15-18: "steering capability"), as in the claim.

Regarding claim 27, the Pelchy apparatus, as modified with the inclusion of the Laser Focus's passive CMOS imager which has timing and control circuitry at each pixel site, has a supplementary circuit board electronically coupled with said first circuit board and said image sensor for enhancing said pre-video signal as specified (Pelchy: figure 2, element 27), as specified.

6. Claims 11-13 and 30-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pelchy in view of 6/97 Laser Focus article entitled "Imaging options expand with CMOS technology" (hereinafter referred to as "Laser Focus") and further in view of Danna et al., (hereinafter referred to as "Danna").

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Pelchy discloses a reduced area imaging device (Pelchy: figure 4), comprising : an image sensor lying in a first plane and including an array of pixels for receiving images thereon (Pelchy: column 3, lines 45-50; column 1, lines 8-10); a circuit board longitudinally aligned with and second plane and electrically coupled to with said image sensor, said first circuit board including circuitry means for converting said pre-video signal to a post-video signal for reception by a stand video device signal for reception by a standard video device (Pelchy: column 3, lines 10-15 and 54-65); and a power supply device coupled with said image sensor for driving said array of pixels, and electrically coupled to said first circuit board for driving said circuit board (Pelchy: column 4, lines 17-25) and that the circuit board is substantially parallel to the image sensor plane, as specified in claim 11. However, Pelchy fails to disclose the that the image sensor further includes timing and control circuitry means on said first plane and coupled to said pixel array such as a CMOS imager (Pelchy: column 3, lines 45-50), even though the reference recognizes that the use of a TAB imager could be also apply CMOS based imager (Pelchy: column 1, lines 7-10). The Laser Focus article discloses that the use of a passive CMOS image sensor timing and control circuitry at each CMOS pixel (Laser Focus: third page, right most column, lines 32-60) is preferable to using a CCD because the standard CCD imagers as contained by the original Pelchy endoscope waste more power (Laser Focus: second page, leftmost column, lines 35-50). Accordingly, given the Laser Focus article's teaching of advantageously using a passive CMOS image sensor, it would have been obvious for one of ordinary skill in the art to modify the Pelchy apparatus by incorporating the Laser Focus article's disclosed passive CMOS imager for the

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standard Pelchy imager (Pelchy: figure 2, element 20) in order to minimize power consumption. The Pelchy apparatus, as modified with the inclusion of the Laser Focus's passive CMOS imager which has timing and control circuitry at each pixel site, has a majority of the features of claim 11, but fails to disclose the parallel positioning of the circuit boards with the image sensor board as in the claim 11. Danna discloses that the parallel arrangement of an image sensor and a circuit board in an endoscopic imaging housing in order to make the imaging head more compact (Danna: column 4, lines 20-68) and thereby reducing patient discomfort (Danna: column 2, lines 35-45). Accordingly, given the Danna teaching it would have been obvious for one of ordinary skill in the art to modify the Pelchy-Laser Focus apparatus to have its CMOS imager and circuitry boards aligned in a parallel fashion as taught by Danna in order to reduce patient discomfort suffer to the larger arrangement as taught by the primary reference (Pelchy: figures 6-7). The Pelchy-Laser-Focus apparatus, further modified by Danna's parallel implementation of the image sensor and circuit board configuration, has all of the features of claim 11.

Regarding claim 12, the Pelchy-Laser-Focus apparatus, further modified by Danna's parallel implementation of the image sensor and circuit board configuration, has an array of passive CMOS pixels which includes a photo diode and access transistor pair (Laser Focus: third page, rightmost column, lines 28-38), as specified.

Regarding claim 13, the Pelchy-Laser-Focus apparatus, further modified by Danna's parallel implementation of the image sensor and circuit board configuration, has a supplementary

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circuit board electronically coupled with said first circuit board and said image sensor for enhancing said pre-video signal as specified (Danna: column 4, lines 30-60), as specified.

Pelchy discloses a reduced area imaging device (Pelchy: figure 4), comprising : an image sensor lying in a first plane and including an array of pixels for receiving images thereon (Pelchy: column 3, lines 45-50; column 1, lines 8-10); a circuit board longitudinally aligned with and second plane and electrically coupled to with said image sensor, said first circuit board including circuitry means for converting said pre-video signal to a post-video signal for reception by a stand video device signal for reception by a standard video device (Pelchy: column 3, lines 10-15 and 54-65); a control box remote from said image sensor, said control box including circuitry means for receiving said pre-video signal from the image sensor as specified (Pelchy: column 3, lines 10-15); and a power supply device coupled with said image sensor for driving said array of pixels, and electrically coupled to said first circuit board for driving said circuit board (Pelchy: column 4, lines 17-25) and that the circuit board is substantially parallel to the image sensor plane, as specified in claim 30. However, Pelchy fails to disclose the that the image sensor is a CMOS image and further includes timing and control circuitry means thereon, even though the reference recognizes that the use of a TAB imager could be also apply CMOS based imager (Pelchy: column 1, lines 7-10). The Laser Focus article discloses that the use of a active CMOS image sensor timing and control circuitry at each CMOS pixel (Laser Focus: second page, rightmost column, lines 4-8) is preferable to using a CCD because the standard CCD imagers as contained by the original Pelchy endoscope waste more power (Laser Focus: second page, leftmost column,

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lines 35-50). Accordingly, given the Laser Focus article's teaching of advantageously using a active CMOS image sensor, it would have been obvious for one of ordinary skill in the art to modify the Pelchy apparatus by incorporating the Laser Focus article's disclosed active CMOS imager for the standard Pelchy imager (Pelchy: figure 2, element 20) in order to minimize power consumption. The Pelchy apparatus, as modified with the inclusion of the Laser Focus's active CMOS imager which has timing and control circuitry at each pixel site, has all of the features of . of claim 30, but fails to disclose the parallel positioning of the circuit boards with the image sensor board as in the claim 30. Danna discloses that the parallel arrangement of an image sensor and a circuit board in an endoscopic imaging housing in order to make the imaging head more compact (Danna: column 4, lines 20-68) and thereby reducing patient discomfort (Danna: column 2, lines 35-45). Accordingly, given the Danna teaching it would have been obvious for one of ordinary skill in the art to modify the Pelchy-Laser Focus apparatus to have it's CMOS imager and circuitry boards aligned in a parallel fashion as taught by Danna in order to reduce patient discomfort suffer to the larger arrangement as taught by the primary reference (Pelchy: figures 6-7). The Pelchy-Laser-Focus apparatus, further modified by Danna's parallel implementation of the image sensor and circuit board configuration, has all of the features of claim 30.

Regarding claim 31, the Pelchy-Laser-Focus apparatus, further modified by Danna's parallel implementation of the image sensor and circuit board configuration, has an array of passive CMOS pixels which includes a photo diode and access transistor pair (Laser Focus: third page, rightmost column, lines 28-38), as specified.



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Pelchy discloses a reduced area imaging device (Pelchy: figure 4), comprising : an image sensor lying in a first plane and including an array of pixels for receiving images thereon (Pelchy: column 3, lines 45-50; column 1, lines 8-10); a circuit board longitudinally aligned with and second plane and electrically coupled to with said image sensor, said first circuit board including circuitry means for converting said pre-video signal to a post-video signal for reception by a stand video device signal for reception by a standard video device (Pelchy: column 3, lines 10-15 and 54-65); a control box remote from said image sensor, said control box including circuitry means for receiving said pre-video signal from the image sensor as specified (Pelchy: column 3, lines 10-15); and a power supply device coupled with said image sensor for driving said array of pixels, and electrically coupled to said first circuit board for driving said circuit board (Pelchy: column 4, lines 17-25) and that the circuit board is substantially parallel to the image sensor plane, as specified in claim 30. However, Pelchy fails to disclose the that the image sensor further includes timing and control circuitry means on said first plane and coupled to said pixel array such as a CMOS imager (Pelchy: column 3, lines 45-50), even though the reference recognizes that the use of a TAB imager could be also apply CMOS based imager (Pelchy: column 1, lines 7-10). The Laser Focus article discloses that the use of a passive CMOS image sensor timing and control circuitry at each CMOS pixel (Laser Focus: third page, right most column, lines 32-60) is preferable to using a CCD because the standard CCD imagers as contained by the original Pelchy endoscope waste more power (Laser Focus: second page, leftmost column, lines 35-50). Accordingly, given the Laser Focus article's teaching of advantageously using a passive CMOS



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image sensor, it would have been obvious for one of ordinary skill in the art to modify the Pelchy apparatus by incorporating the Laser Focus article's disclosed passive CMOS imager for the standard Pelchy imager (Pelchy: figure 2, element 20) in order to minimize power consumption. The Pelchy apparatus, as modified with the inclusion of the Laser Focus's passive CMOS imager which has timing and control circuitry at each pixel site, has a majority of the features of claim 30, but fails to disclose the parallel positioning of the circuit boards with the image sensor board as in the claim 30. Danna discloses that the parallel arrangement of an image sensor and a circuit board in an endoscopic imaging housing in order to make the imaging head more compact (Danna: column 4, lines 20-68) and thereby reducing patient discomfort (Danna: column 2, lines 35-45). Accordingly, given the Danna teaching it would have been obvious for one of ordinary skill in the art to modify the Pelchy-Laser Focus apparatus to have its CMOS imager and circuitry boards aligned in a parallel fashion as taught by Danna in order to reduce patient discomfort suffer to the larger arrangement as taught by the primary reference (Pelchy: figures 6-7). The Pelchy-Laser-Focus apparatus, further modified by Danna's parallel implementation of the image sensor and circuit board configuration, has all of the features of claim 30.

Regarding claim 32, Pelchy-Laser-Focus apparatus, further modified by Danna's parallel implementation of the image sensor and circuit board configuration, has an amplifier for each individual pixel (Laser Focus: second page, rightmost column, lines 4-9), as in the claim.

7. Claims 4-5, and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pelchy in view of 6/97 Laser Focus article entitled "Imaging options expand with CMOS technology"

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(hereinafter referred to as "Laser Focus") as applied to preceding claims 1, 3, and above, and further in view of Danna et al., (hereinafter referred to as "Danna").

The Pelchy apparatus, as modified with the inclusion of the Laser Focus disclosed CMOS imager, has all of the features of claims 1, 3, and 23, but fails to disclose the parallel positioning of the circuit boards with the image sensor board as in the claims 4-5 and 23.

Danna discloses that the parallel arrangement of an image sensor and a circuit board in an endoscopic imaging housing in order to make the imaging head more compact (Danna: column 4, lines 20-68) and thereby reducing patient discomfort (Danna: column 2, lines 35-45).

Accordingly, given the Danna teaching it would have been obvious for one of ordinary skill in the art to modify the Pelchy-Laser Focus apparatus to have its CMOS imager and circuitry boards aligned in a parallel fashion as taught by Danna in order to reduce patient discomfort suffer to the larger arrangement as taught by the primary reference (Pelchy: figures 6-7). The Pelchy-Laser-Focus apparatus, further modified by Danna's parallel implementation of the image sensor and circuit board configuration, has all of the features of claims 4-5, and 23.

8. Claims 22 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pelchy in view of 6/97 Laser Focus article entitled "Imaging options expand with CMOS technology" (hereinafter referred to as "Laser Focus") as applied to claims 14 and 24 above, and further in view of Steinberg.

The Pelchy apparatus, as modified with the inclusion of the Laser Focus disclosed CMOS imager, has all of the features of claims 22 and 29, but fails to disclose the use of a power supply

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as being configured as a battery attached to the handle of the endoscope, as in claims 22 and 29. Steinberg discloses that it is known to incorporate the use of an attachably detachable battery as a power source (Steinberg: column 4, lines 60-68; column 5, lines 1-40; figure 7, element 208) within an endoscope's handle (Steinberg: column 3, lines 50-55) in order to make the endoscope useable at remote sites (i.e. portable) and further decrease the set-up time the use of the apparatus (Steinberg: column 2, lines 18-43). Given Steinberg's teaching of using a battery as a power source within the handle of an endoscope, it would have been further obvious for one of ordinary skill in the art to incorporate the handle contained battery of Steinberg into the composite Pelchy-Laser Focus article discussed apparatus, in order to reduce to the set-up time of the original Pelchy-Laser Focus article discussed apparatus. The Pelchy endoscope now incorporating both the Laser Focus article discussed CMOS imager and the Steinberg's battery handled power supply, has all of the features of claim 22 and 29.

### *Conclusion*

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Anand Rao whose telephone number is (703)-305-4813 .

Patent Examiner  
Anand S. Rao  
Art Unit 2713

Serial Number: 09/175,685

Page 22

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ANAND S. RAO  
PATENT EXAMINER  
*ASR*

asr

August 6, 1999

FORM PTO-1449		Docket Number F97.13 CIP2		Application Number 09/175,685			
INFORMATION DISCLOSURE CITATION IN AN APPLICATION (Use several sheets if necessary)		Applicant Edwin L. Adair, Jeffrey L. Adair, Randall S. Adair					
		Filing Date October 20, 1998		Group Art Unit 2713			
U.S. PATENT DOCUMENTS							
EXAMINER INITIAL	DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE	
AR	4,745,471	05/17/88	Takamura, et al.	358	98		
AR	4,786,965	11/22/88	Yabe	358	98		
AR	4,814,648	03/21/89	Hynecek	307	497		
AR	4,854,302	08/08/89	Allred, III	128	6		
AR	4,869,246	09/26/89	Adair	128	303.1		
AR	4,942,473	07/17/90	Zeevi, et al.	348	76		
AR	RE. 33,854	03/24/92	Adair	128	6		
AR	5,116,317	05/26/92	Carson, Jr., et al.	604	96		
AR	5,162,913	11/10/92	Chatenever, et al.	358	209		
AR	5,220,198	06/15/93	Tsuji	257	731	04/29/91	
AR	5,251,613	10/12/93	Adair	128	6		
AR	5,381,784	01/17/95	Adair	128	6		
AR	5,402,768	04/04/95	Adair	128	4		
AR	5,471,515	11/28/95	Fossum, et al.	377	60		
AR	5,489,256	02/06/96	Adair	600	133		
AR	5,605,531	02/25/97	Lane, et al.	600	118		
AR	5,630,782	05/20/97	Adair	600	133		
AR	5,630,783	05/20/97	Steinberg	600	158		
AR	5,682,199	10/28/97	Lankford	348	72		
AR	5,701,155	12/23/97	Wood, et al.	348	72		
AR	5,734,418	03/31/98	Danna	348	76		
AR	5,754,313	05/19/98	Pelchy, et al.	348	76		
FOREIGN PATENT DOCUMENTS							
	DOCUMENT NUMBER	DATE	COUNTRY	CLASS	SUBCLASS	Translation	
						YES	NO
AR	0 492 349 A1	07/01/92	European Patent Office			x	

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)	
AL	"Active-Pixel Image Sensor Integrated With Readout Circuits", <i>NASA Tech Briefs</i> , October 1996
AL	"NASA's Tiny Camera Has a Wide-Angle Future", <i>Business Week</i> , March 6, 1995
AL	"Imaging Options Expand With CMOS Technology", <i>Laser Focus World</i> , June 1997
AL	"Applications Hold the Key to Imager Choice", <i>Photonics Spectra</i> , March 1997
EXAMINER A. RAO	DATE CONSIDERED 8/2/99
EXAMINER: Initial if citation considered, whether or not citation is in conformance with MPEP §609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to the applicant.	

PTO/SB/08 (2-92)

Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE



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FEB 25 1999

Group 2700

[illegible]



09/175685

NOTICE OF DRAFTSPERSON'S  
PATENT DRAWING REVIEW

The drawing(s) filed (insert date)

10/20/98

A. ☒ approved by the Draftsperson under 37 CFR 1.84 or 1.152.B. ☐ objected to by the Draftsperson under 37 CFR 1.84 or 1.152 for the reasons indicated below. The Examiner will require submission of new, corrected drawings when necessary. Corrected drawing must be submitted according to the instructions on the back of this notice.

1. DRAWINGS. 37 CFR 1.84(a): Acceptable categories of drawings:  
Black ink. Color.  
Color drawings are not acceptable until petition is granted.  
Fig(s) \_\_\_\_\_  
Pencil and non black ink not permitted. Fig(s) \_\_\_\_\_
2. PHOTOGRAPHS. 37 CFR 1.84 (b)  
1 full-tone set is required. Fig(s) \_\_\_\_\_  
Photographs not properly mounted (must use bristol board or photographic double-weight paper). Fig(s) \_\_\_\_\_  
Poor quality (half-tone). Fig(s) \_\_\_\_\_
3. TYPE OF PAPER. 37 CFR 1.84(e)  
Paper not flexible, strong, white, and durable.  
Fig(s) \_\_\_\_\_  
Erasures, alterations, overwritings, interlineations, folds, copy machine marks not accepted. Fig(s) \_\_\_\_\_  
Mylar, velum paper is not acceptable (too thin).  
Fig(s) \_\_\_\_\_
4. SIZE OF PAPER. 37 CFR 1.84(f): Acceptable sizes:  
21.0 cm by 29.7 cm (DIN size A4)  
21.6 cm by 27.9 cm (8 1/2 x 11 inches)  
All drawing sheets not the same size.  
Sheet(s) \_\_\_\_\_  
Drawing sheets not an acceptable size. Fig(s) \_\_\_\_\_
5. MARGINS. 37 CFR 1.84(g): Acceptable margins:  
Top 2.5 cm Left 2.5 cm Right 1.5 cm Bottom 1.0 cm  
SIZE: A4 Size  
Top 2.5 cm Left 2.5 cm Right 1.5 cm Bottom 1.0 cm  
SIZE: 8 1/2 x 11  
Margins not acceptable. Fig(s) \_\_\_\_\_  
Top (T) \_\_\_\_\_ Left (L) \_\_\_\_\_  
Right (R) \_\_\_\_\_ Bottom (B) \_\_\_\_\_
6. VIEWS. 37 CFR 1.84(h)  
REMINDER: Specification may require revision to correspond to drawing changes.  
Partial views. 37 CFR 1.84(h)(2)  
Brackets needed to show figure as one entity.  
Fig(s) \_\_\_\_\_  
Views not labeled separately or properly.  
Fig(s) \_\_\_\_\_  
Enlarged view not labeled separately or properly.  
Fig(s) \_\_\_\_\_
7. SECTIONAL VIEWS. 37 CFR 1.84 (h)(3)  
Hatching not indicated for sectional portions of an object.  
Fig(s) \_\_\_\_\_  
Sectional designation should be noted with Arabic or Roman numbers. Fig(s) \_\_\_\_\_
8. ARRANGEMENT OF VIEWS. 37 CFR 1.84(i)  
Words do not appear on a horizontal, left-to-right fashion when page is either upright or turned so that the top becomes the right side, except for graphs. Fig(s) \_\_\_\_\_
9. SCALE. 37 CFR 1.84(k)  
Scale not large enough to show mechanism without crowding when drawing is reduced in size to two-thirds in reproduction.  
Fig(s) \_\_\_\_\_
10. CHARACTER OF LINES, NUMBERS, & LETTERS. 37 CFR 1.84(i)  
Lines, numbers & letters not uniformly thick and well defined, clean, durable, and black (poor line quality).  
Fig(s) \_\_\_\_\_
11. SHADING. 37 CFR 1.84(m)  
Solid black areas pale. Fig(s) \_\_\_\_\_  
Solid black shading not permitted. Fig(s) \_\_\_\_\_  
Shade lines, pale, rough and blurred. Fig(s) \_\_\_\_\_
12. NUMBERS, LETTERS, & REFERENCE CHARACTERS. 37 CFR 1.84(p)  
Numbers and reference characters not plain and legible.  
Fig(s) \_\_\_\_\_  
Figure legends are poor. Fig(s) \_\_\_\_\_  
Numbers and reference characters not oriented in the same direction as the view. 37 CFR 1.84(p)(1)  
Fig(s) \_\_\_\_\_  
English alphabet not used. 37 CFR 1.84(p)(2)  
Fig(s) \_\_\_\_\_  
Numbers, letters and reference characters must be at least .32 cm (1/8 inch) in height. 37 CFR 1.84(p)(3)  
Fig(s) \_\_\_\_\_
13. LEAD LINES. 37 CFR 1.84(q)  
Lead lines cross each other. Fig(s) \_\_\_\_\_  
Lead lines missing. Fig(s) \_\_\_\_\_
14. NUMBERING OF SHEETS OF DRAWINGS. 37 CFR 1.84(i)  
Sheets not numbered consecutively, and in Arabic numerals beginning with number 1. Sheet(s) \_\_\_\_\_
15. NUMBERING OF VIEWS. 37 CFR 1.84(u)  
Views not numbered consecutively, and in Arabic numerals, beginning with number 1. Fig(s) \_\_\_\_\_
16. CORRECTIONS. 37 CFR 1.84(w)  
Corrections not made from prior PTO-948 dated \_\_\_\_\_
17. DESIGN DRAWINGS. 37 CFR 1.152  
Surface shading shown not appropriate. Fig(s) \_\_\_\_\_  
Solid black shading not used for color contrast.  
Fig(s) \_\_\_\_\_

COMMENTS

REVIEWER

A.D.

DATE

8/6/99

TELEPHONE NO.

ATTACHMENT TO PAPER NO.

9



JP 27130

Please type a plus sign (+) inside this box → ☐

PTO/SB/21 (6-98)  
Approved for use through 09/30/2000. OMB 0651-0031  
Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

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## TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Total Number of Pages in This Submission **3**

Application Number	09/175,685
Filing Date	October 20, 1998
First Named Inventor	Edwin L. Adair, et al
Group Art Unit	2713
Examiner Name	A. Rao
Attorney Docket Number	F97.13 CIP2

### ENCLOSURES (check all that apply)

- ☒ Fee Transmittal Form
- ☒ Fee Attached
- ☒ Amendment / Response
  - ☐ After Final
  - ☐ Affidavits/declaration(s)
- ☐ Extension of Time Request
- ☐ Express Abandonment Request
- ☐ Information Disclosure Statement
- ☐ Certified Copy of Priority Document(s)
- ☐ Response to Missing Parts/ Incomplete Application
  - ☐ Response to Missing Parts under 37 CFR 1.52 or 1.53

- ☐ Assignment Papers (for an Application)
- ☐ Drawing(s)
- ☐ Licensing-related Papers
- ☐ Petition Routing Slip (PTO/SB/69) and Accompanying Petition
- ☐ Petition to Convert to a Provisional Application
- ☐ Power of Attorney, Revocation Change of Correspondence Address
- ☐ Terminal Disclaimer
- ☐ Small Entity Statement
- ☐ Request for Refund

- ☐ After Allowance Communication to Group
- ☐ Appeal Communication to Board of Appeals and Interferences
- ☐ Appeal Communication to Group (Appeal Notice, Brief, Reply Brief)
- ☐ Proprietary Information
- ☐ Status Letter
- ☐ Additional Enclosure(s) (please identify below):

Remarks

### SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm or Individual name: Brent P. Johnson Fields & Johnson, P.C.

Signature

Date

7/29/99

### CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231 on this date: 7/29/99

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Date

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# FEE TRANSMITTAL

## for FY 1999

Patent fees are subject to annual revision.  
Small Entity payments must be supported by a small entity statement,  
otherwise large entity fees must be paid. See Forms PTO/SB/09-12.  
See 37 C.F.R. §§ 1.27 and 1.28.

TOTAL AMOUNT OF PAYMENT (\$) 18.00

### Complete if Known

Application Number	09/175,685
Filing Date	October 20, 1998
First Named Inventor	Edwin L. Adair, et al.
Examiner Name	A. Rao
Group / Art Unit	2713
Attorney Docket No.	F97.13 CIP2

### METHOD OF PAYMENT (check one)

1. ☒ The Commissioner is hereby authorized to charge indicated fees and credit any over payments to:

Deposit Account Number 06-0778

Deposit Account Name Fields & Johnson, P.C.

☒ Charge Any Additional Fee Required Under 37 CFR §§ 1.16 and 1.17

2. ☒ Payment Enclosed:  
☒ Check ☐ Money Order ☐ Other

### FEE CALCULATION

#### 1. BASIC FILING FEE

Large Entity	Small Entity	Fee Code (\$)	Fee Code (\$)	Fee Description	Fee Paid
101	760	201	380	Utility filing fee	
106	310	206	155	Design filing fee	
107	480	207	240	Plant filing fee	
108	760	208	380	Reissue filing fee	
114	150	214	75	Provisional filing fee	

SUBTOTAL (1) (\$)

#### 2. EXTRA CLAIM FEES

Total Claims	Extra Claims	Fee from below	Fee Paid
34	20** = 2	9	18
Independent Claims	3** = 0	39	0
Multiple Dependent			

\*\*or number previously paid, if greater; For Reissues, see below

Large Entity	Small Entity	Fee Code (\$)	Fee Code (\$)	Fee Description	Fee Paid
103	18	203	9	Claims in excess of 20	
102	78	202	39	Independent claims in excess of 3	
104	260	204	130	Multiple dependent claim, if not paid	
109	78	209	39	** Reissue independent claims over original patent	
110	18	210	9	** Reissue claims in excess of 20 and over original patent	

SUBTOTAL (2) (\$) 18.00

### FEE CALCULATION (continued)

#### 3. ADDITIONAL FEES

Large Entity	Small Entity	Fee Code (\$)	Fee Code (\$)	Fee Description	Fee Paid
105	130	205	65	Surcharge - late filing fee or oath	
127	50	227	25	Surcharge - late provisional filing fee or cover sheet	
139	130	139	130	Non-English specification	
147	2,520	147	2,520	For filing a request for reexamination	
112	920*	112	920*	Requesting publication of SIR prior to Examiner action	
113	1,840*	113	1,840*	Requesting publication of SIR after Examiner action	
115	110	215	55	Extension for reply within first month	
116	380	216	190	Extension for reply within second month	
117	870	217	435	Extension for reply within third month	
118	1,360	218	680	Extension for reply within fourth month	
128	1,850	228	925	Extension for reply within fifth month	
119	300	219	150	Notice of Appeal	
120	300	220	150	Filing a brief in support of an appeal	
121	260	221	130	Request for oral hearing	
138	1,510	138	1,510	Petition to institute a public use proceeding	
140	110	240	55	Petition to revive - unavoidable	
141	1,210	241	605	Petition to revive - unintentional	
142	1,210	242	605	Utility issue fee (or reissue)	
143	430	243	215	Design issue fee	
144	580	244	290	Plant issue fee	
122	130	122	130	Petitions to the Commissioner	
123	50	123	50	Petitions related to provisional applications	
126	240	126	240	Submission of Information Disclosure Stmt	
581	40	581	40	Recording each patent assignment per property (times number of properties)	
146	760	246	380	Filing a submission after final rejection (37 CFR § 1.129(a))	
149	760	249	380	For each additional invention to be examined (37 CFR § 1.129(b))	

Other fee (specify) \_\_\_\_\_

Other fee (specify) \_\_\_\_\_

\*Reduced by Basic Filing Fee Paid

SUBTOTAL (3) (\$) 0

### SUBMITTED BY

Name (Print/Type)	Brent P. Johnson	Registration No. (Attorney/Agent)	38,031	Complete (if applicable)	Telephone	303-689-9100
Signature				Date	7/29/99	

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J. Douglas  
8/13/99

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re the Continuation in Part ) SECOND SUPPLEMENTAL  
Application of ) PRELIMINARY  
 ) AMENDMENT

Edwin L. Adair, Jeffrey L. Adair, )  
Randall S. Adair ) Examiner: A. Rao

Serial No.: 09/175,685 ) Art Unit: 2713

Filed: October 20, 1998 )

For: "Reduced Area Imaging  
Devices" )

I hereby certify that this correspondence is being  
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D.C. 20231, on

7/29/99  
(Date of Deposit)

*Katherine L. Douglas*  
Name of applicant, assignee, or Registered Rep

Assistant Commissioner for Patents  
Washington, D.C. 20231

Sir:

Please amend the above-identified application as follows:

IN THE CLAIMS:

SUB F1

24. (Amended) An endoscope comprising:  
a tubular portion including a central passageway extending  
therethrough, a proximal end and a distal end;  
a CMOS image sensor positioned at said distal end of said  
5 tubular portion for receiving images of a surgical site, said CMOS imager  
defined by an array of CMOS pixels and [wherein individual pixels within  
said array of said CMOS pixels each include an amplifier], said CMOS  
imager lying in a first plane;  
circuitry means for timing and control of said CMOS image  
10 sensor placed adjacent to said CMOS image sensor on said first plane;  
a control box remote from said tubular portion and coupled to  
said CMOS image sensor, said control box including circuitry means for  
receiving a pre-video signal from said CMOS image sensor, and for

*Cl  
cancel.*

15

converting said pre-video signal to a post-video signal which may be received by a standard video device; and  
a power supply coupled to said control box and said CMOS image sensor for providing power thereto.

Add the following new claims:

- C2*
33. An endoscope, as claimed in claim 24, wherein:  
individual pixels within said array of CMOS pixels each include an amplifier.
34. An endoscope, as claimed in claim 24, wherein:  
said array of CMOS pixels includes a plurality of passive CMOS pixels, and wherein individual passive CMOS pixels of said plurality of passive CMOS pixels each include a photo diode for producing photo electrically generated signals, and an access transistor communicating with said photo diode to control the release of said photo electrically generated signals.

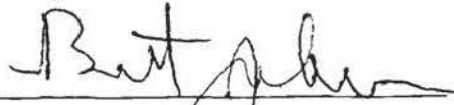
### REMARKS

By the foregoing, Claim 24 has been amended, and new Claims 33 and 34 have been added. As a review of the claims in this application, Claims 1-7 were filed originally with the application, Claims 8-29 were added in the Preliminary Amendment filed on March 8, 1999, and Claims 30-32 were added in a first Supplementary Preliminary Amendment filed on March 24, 1999. Enclosed herewith is a check in the amount of \$18.00

to cover the additional fees for new Claims 33 and 34. Any shortfall may be charged to Deposit Account No. 06-0778.

Respectfully submitted,

FIELDS & JOHNSON, P.C.

A handwritten signature in dark ink, appearing to read "Brent Johnson", is written over a horizontal line.

Gary D. Fields

Brent P. Johnson

8480 East Orchard Road, Suite 5600

Englewood, CO 80111

(303) 689-9100

Date: 7/29/99





UNITED STATES DEPARTMENT OF COMMERCE  
Patent and Trademark Office

Address: COMMISSIONER OF PATENTS AND TRADEMARKS  
Washington, D.C. 20231

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
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09/175,685 10/20/98 ADAIR

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LM12/0901

└

EXAMINER

BRENT P JOHNSON  
FIELDS & JOHNSON  
SUITE 5600  
3480 EAST ORCHARD ROAD  
ENGLEWOOD CO 80111

RAD. A

ART UNIT

PAPER NUMBER

2713

DATE MAILED:

09/01/99

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks



# Interview Summary

Application No.  
09/175,685

Applicant(s)

Adair et al.

Examiner

Anand Rao

Group Art Unit

2713

All participants (applicant, applicant's representative, PTO personnel):

(1) Anand Rao

(3) \_\_\_\_\_

(2) Mr. Brent Johnson (#38,031)

(4) \_\_\_\_\_

Date of Interview Aug 31, 1999

Type: ☐ Telephonic ☒ Personal (copy is given to ☒ applicant ☐ applicant's representative).

Exhibit shown or demonstration conducted: ☐ Yes ☒ No. If yes, brief description:

Agreement ☒ was reached. ☐ was not reached.

Claim(s) discussed: 1-32

Identification of prior art discussed:

US Patent 5,754,313 to Pelchy et al. and US Patent 4,491,865 to Danna et al.

Description of the general nature of what was agreed to if an agreement was reached, or any other comments:

The proposed amendment and the filed Declarations of 4/6/99 were reviewed by the Examiner as putting claims 6, 11, 14, 24, and 30 a favorable condition for allowance. The Examiner further suggested the incorporation of the "direct video" limitation of claim 1 in lieu of the "pin connector" limitation in order to place claim 1 in said same favorable condition for allowance.

(A fuller description, if necessary, and a copy of the amendments, if available, which the examiner agreed would render the claims allowable must be attached. Also, where no copy of the amendments which would render the claims allowable is available, a summary thereof must be attached.)

1. ☐ It is not necessary for applicant to provide a separate record of the substance of the interview.

Unless the paragraph above has been checked to indicate to the contrary, A FORMAL WRITTEN RESPONSE TO THE LAST OFFICE ACTION IS NOT WAIVED AND MUST INCLUDE THE SUBSTANCE OF THE INTERVIEW. (See MPEP Section 713.04). If a response to the last Office action has already been filed, APPLICANT IS GIVEN ONE MONTH FROM THIS INTERVIEW DATE TO FILE A STATEMENT OF THE SUBSTANCE OF THE INTERVIEW.

2. ☐ Since the Examiner's interview summary above (including any attachments) reflects a complete response to each of the objections, rejections and requirements that may be present in the last Office action, and since the claims are now allowable, this completed form is considered to fulfill the response requirements of the last Office action. Applicant is not relieved from providing a separate record of the interview unless box 1 above is also checked.

**ANAND S. RAO**  
**PATENT EXAMINER**

**ANAND RAO**  
**PATENT EXAMINER**  
**ART UNIT 2713**

Examiner Note: You must sign and stamp this form unless it is an attachment to a signed Office action.



Please type a plus sign (+) inside this box → ☐

PTO/SB/21 (6-98)  
Approved for use through 09/30/2000. OMB 0651-0031  
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Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

<b>TRANSMITTAL FORM</b> (to be used for all correspondence after initial filing)	Application Number	09/175,685	
	Filing Date	10/20/98	
	First Named Inventor	Adair et al.	
	Group Art Unit	2713	
	Examiner Name	A. Rao	
Total Number of Pages in This Submission	15	Attorney Docket Number	F97.13CIP2

ENCLOSURES (check all that apply)		
<input type="checkbox"/> Fee Transmittal Form	<input type="checkbox"/> Assignment Papers (for an Application)	<input type="checkbox"/> After Allowance Communication to Group
<input type="checkbox"/> Fee Attached	<input type="checkbox"/> Drawing(s)	<input type="checkbox"/> Appeal Communication to Board of Appeals and Interferences
<input checked="" type="checkbox"/> Amendment / Response	<input type="checkbox"/> Licensing-related Papers	<input type="checkbox"/> Appeal Communication to Group (Appeal Notice, Brief, Reply Brief)
<input type="checkbox"/> After Final	<input type="checkbox"/> Petition Routing Slip (PTO/SB/69) and Accompanying Petition	<input type="checkbox"/> Proprietary Information
<input type="checkbox"/> Affidavits/declaration(s)	<input type="checkbox"/> Petition to Convert to a Provisional Application	<input type="checkbox"/> Status Letter
<input type="checkbox"/> Extension of Time Request	<input type="checkbox"/> Power of Attorney, Revocation Change of Correspondence Address	<input checked="" type="checkbox"/> Additional Enclosure(s) (please identify below):
<input type="checkbox"/> Express Abandonment Request	<input type="checkbox"/> Terminal Disclaimer	Express Mailing Form (EL245411015US)
<input type="checkbox"/> Information Disclosure Statement	<input type="checkbox"/> Small Entity Statement	
<input type="checkbox"/> Certified Copy of Priority Document(s)	<input type="checkbox"/> Request for Refund	
<input type="checkbox"/> Response to Missing Parts/Incomplete Application	Remarks	
<input type="checkbox"/> Response to Missing Parts under 37 CFR 1.52 or 1.53		

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT	
Firm or Individual name	Brent P. Johnson
Signature	
Date	September 1, 1999

CERTIFICATE OF MAILING			
I hereby certify that this correspondence is being deposited with the United States Postal Service as <u>Express Mail</u> envelope addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231 on this date: <u>09/01/99</u>			
Typed or printed name	Virginia A. Sawatzke		
Signature		Date	09/01/99

Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.



JP. 2713

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re the Continuation in Part )  
Application of )  
Edwin L. Adair, Jeffrey L. Adair, ) Examiner: A. Rao  
Randall S. Adair ) Art Unit: 2713  
Serial No.: 09/175,685 )  
Filed: October 20, 1998 )  
For: "Reduced Area Imaging Devices" )

Assistant Commissioner for Patents  
Washington, D.C. 20231

"Express Mail" mailing label number EL245411015US

Date of Deposit: September 1, 1999

I hereby certify that the following:

- Transmittal Form
- Amendment
- Return postcard

are being deposited with the United States Postal Service "Express Mail  
Post Office to Addressee" service under 37 CFR 1.10 on the date indicated  
above and are addressed to Assistant Commissioner For Patents,  
Washington, DC 20231.

Virginia A. Sawatzke  
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8480 East Orchard Road, Suite 5600  
Englewood, CO 80111  
(303) 689-9100

Date: Sept. 1, 1999



1210  
J. Douglas  
9/7/99

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re the Continuation in Part  
Application of

Edwin L. Adair, Jeffrey L. Adair,  
Randall S. Adair

Serial No.: 09/175,685

Filed: October 20, 1998

For: "Reduced Area Imaging Devices")

Assistant Commissioner for Patents  
Washington, D.C. 20231

Sir:

This Amendment is responsive to the Office Action dated  
August 6, 1999, the above-identified application being amended as follows:

IN THE CLAIMS:

Amend Claim 1 as follows:

SUB E1

1. (Amended) A reduced area imaging device comprising:  
an imager sensor lying in a first plane and including an array  
of CMOS pixels for receiving images thereon, said image sensor further  
including circuitry means on said first plane and coupled to said array of  
5 CMOS pixels for timing and control of said array of CMOS pixels, said  
image sensor producing a pre-video signal;

) AMENDMENT

) Examiner: A. Rao

) Art Unit: 2713

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) Commissioner for Patents, Washington, D.C. 20231

Virginia A. Sawatzke  
(Typed or printed name of person mailing paper or fee)

Virginia A. Sawatzke  
(Signature of person mailing paper or fee)

*D<sup>1</sup> cancel.*

a pre-video conductor for transmitting said pre-video signal, said pre-video conductor having first and second ends, said first end communicating with said image sensor;

10 a first circuit board lying in a second plane and longitudinally aligned with said image sensor, said first circuit board being connected to said pre-video conductor at said second end thereof, said first circuit board including circuitry means for converting said pre-video signal to a post-video signal for direct reception by a standard video device; and

15 a power supply electrically coupled with said image sensor for driving said array of pixels and said timing and control means, and electrically coupled to said first circuit board for driving said circuit board.

Claim 3, line 5, after "said" insert --first--.

✓  
Amend Claim 6 as follows:

SUB E2

*D<sup>2</sup>*

5 6. (Amended) A reduced area imaging device comprising:  
an image sensor lying in a first plane and including an array of CMOS pixels for receiving images thereon, said image sensor further including circuitry means on said first plane and coupled to said array of CMOS pixels for timing and control of said array of CMOS pixels, said image sensor producing a pre-video signal;

10 a control box remote from said image sensor, said control box including circuitry means for receiving said pre-video signal from said image sensor, and for converting said pre-video signal to a post-video signal which may be received by a standard video device; and

a power supply coupled to said control box and said image sensor for providing power thereto.

Amend Claim 8 as follows:

8. (Amended) A reduced area imaging device, as claimed in claim 1, wherein said [image sensor] array of CMOS pixels further includes:

- D<sup>3</sup>
- 5 an array of passive CMOS pixels, wherein individual passive CMOS pixels of said array of passive CMOS pixels each includes a photo diode for producing photoelectrically generated signals[;] and an access transistor communicating with said photo diode to control the release of said photoelectrically generated signals.

Cancel Claims 9 and 10 without prejudice.

Amend Claim 11 as follows:

SUB E3

- D<sup>4</sup>
- 5 11. (Amended) A reduced area imaging device comprising:  
an array of CMOS pixels defining a profile area and lying in a first plane, said array of CMOS pixels for receiving images thereon;  
a circuit board longitudinally aligned with and electrically [couples] coupled to said array of CMOS pixels, said circuit board lying in a second plane which is offset from said first plane and substantially parallel to said first plane, said circuit board including circuitry means for timing and control of said array of CMOS pixels, said timing and control means producing a pre-video signal, said circuit board further including  
10 circuitry means for receiving said pre-video signal from said timing and control means and converting said pre-video signal to a post-video output signal for direct reception by a video device; and  
a power supply electrically coupled to said array of said CMOS pixels and said circuit board.



✓  
Amend Claim 14 as follows:

12. 14. (Amended) An endoscope with integral imaging capability  
for producing images to be viewed on a video device, said endoscope  
comprising:

a tubular portion including a distal end, a proximal end and a  
5 central passageway extending therethrough;  
means for providing light to said distal end to illuminate a  
surgical site;

D<sup>5</sup>  
a CMOS image sensor lying in a first plane and positioned at  
said distal end of said tubular portion for receiving images of the surgical  
10 site, said CMOS image sensor defining a profile area, and said CMOS  
image sensor producing an image signal;

circuitry means electrically coupled to said CMOS image  
sensor for timing and control of said CMOS image sensor, said circuitry  
means for timing and control placed within said tubular portion;

15 a video processor board lying in a second plane spaced from  
and longitudinally aligned with said CMOS image sensor within said  
tubular portion and adjacent said distal end thereof, and communicating  
with said CMOS image sensor to receive said image signal, said video  
processor board including circuitry means for processing said image signal  
20 and converting said image signal to a post-video signal for direct reception  
by the video device, said video processor board being positioned so as not  
to extend substantially beyond said profile area, [said video processor  
board communicating with said CMOS image sensor to receive said image  
signal]; and

25 a power supply electrically coupled to said CMOS image  
sensor and said video processor board.



Amend Claim 28 as follows:

26, 28 (Amended) An endoscope, as claimed in claim 24<sup>22</sup>, further including:  
a lens positioned at said distal end of said tubular portion of  
sensor.

### REMARKS

Applicant's attorney sincerely appreciates the personal interview so courteously granted by Examiner Rao on August 31, 1999. Pursuant to the interview, it was understood that each of the claims as amended above would define over the prior art. The following includes applicant's full response to the Office Action, and supporting arguments as presented in the interview.

Claim 28 was objected to. Claim 28 has been rewritten. Apparently when Claim 28 was originally filed, a line of text was deleted in the page containing this claim which caused the discrepancy. Therefore, the objection to Claim 28 should be withdrawn.

Claims 1-3, 6-10, 14-21 and 24-27 were rejected under 35 U.S.C. §103 as being unpatentable over Pelchy, et al. in view of the 6/97 *Laser Focus* article entitled "Imaging Options Expand With CMOS Technology." The Examiner stated that Pelchy fails to disclose that the image sensor further includes timing and control circuitry means on said first plane and coupled to said pixel array such as a CMOS imager, even though the reference recognizes that the use of a TAB imager could also apply to a CMOS-based imager. The Examiner further stated that the *Laser Focus*

article is preferable to using a CCD imager because CMOS imagers minimize power consumption.

Obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. *In re Fine*, 837 Fed.2d 1071 (Fed. Cir. 1988). A reference should be considered as a whole, and portions arguing against or teaching away from the claimed invention must be considered. *Bausch & Lomb, Inc. v. Barnes/Hinde/Hydrocurve, Inc.*, 796 Fed.2d 443 (Fed. Cir. 1996). Where the teachings of two or more prior art references conflict, the Examiner must weigh the power of each reference to suggest solutions to one of ordinary skill in the art, considering the degree to which one reference might accurately discredit another. *In re Young*, 927 Fed.2d 588 (Fed. Cir. 1991). If the proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. *In re Gordon*, 733 Fed.2d 900 (Fed. Cir. 1984). If the proposed modification or combination of the prior would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious. *In re Ratti*, 270 Fed.2d 810 (CCPA 1959).

In the present case, the Examiner argues that modification of the primary reference (Pelchy, et al.) is proper because use of a TAB imager could also be applied to a CMOS-based imager. Applicant respectfully disagrees with the Examiner's conclusion and believes that there is express teaching away from the combination of the two references.

The Examiner relies on the suggestion of interchanging a CMOS imager with a TAB imager as found in Pelchy, et al. at column 1, lines 7-10. This portion reads "The increased availability of smaller solid state imagers based on CCD or CMOS technologies has surpassed the availability of conventional wire bonding techniques to take full advantage of the space savings afforded by these small imagers."

Taken in the context of Pelchy as a whole, this sentence simply means that as applied to wire bonding techniques for interconnecting electronic components, CCD and CMOS technology has surpassed these traditional wire bonding techniques such that it is actually the wire bonding techniques which place a limitation on how small an imager can be packaged. It is improper to interpret this sentence as meaning that the TAB imager disclosed in Pelchy is applicable universally to all CCD and CMOS imagers, or that any CCD or CMOS imager is substitutable for the TAB imager disclosed.

The *Laser Focus* article at the first page, column 2, first full paragraph, specifically discusses why substituting CMOS technology for standard CCD technology, such as disclosed in Pelchy, et al., is impractical for purposes of creating imaging devices which are more like cameras on a chip, as opposed to imaging devices which are found on multiple circuit boards. Here, the article states that "By shifting imager designs to CMOS processing, designers can implement many camera functions on a chip . . . many of the functions that were previously performed by a frame grabber or that required external control can now be implemented on-chip as well." Furthermore, the article discusses why it may not be desirable to simply substitute a CMOS imager with a CCD imager. At the fourth page of the article, in the sub-section entitled "Performance trade-offs," the article

states "Just as application needs vary, so will imager based camera systems. No CMOS imager will satisfy every application, and there are finite limits to the practical uses of the technology. For example, the (CMOS) devices will not in the foreseeable future be available to the ultra-low noise scientific market that niche will remain filled by the CCD or CCD/CMOS hybrid. . . . A photodiode array can be read in a non-integration mode, so applications requiring this performance will remain outside the province of CMOS imagers." Therefore, it is clear that some CCD devices have distinct advantages over CMOS devices, and visa versa. Thus, this article makes it clear that, absent some more clear suggestion or motivation found in the references, one cannot simply substitute one imaging device for the other because each has its own advantages depending upon the particular application.

Pelchy, et al. is directed to an improvement wherein the TAB imager package is made shorter in length as compared to the prior art (column 2, lines 66-67; column 3, lines 1-5). In short, Pelchy, et al. takes the single circuit board of the prior art (Reference No. 115, Figure 10) and breaks this circuit board in half to create two smaller circuit boards (Reference Nos. 27 and 28 of Figure 2). The reduction in length of the circuit board trailing the image sensor requires the use of "tape automated bonding" (TAB) in order to connect the imager sensor to its timing and control circuitry. It is clear from a full reading of Pelchy, et al. that the type of invention disclosed is only relevant to imagers which are enhanced by the use of tape automated bonding. The tape automated bonding is used to maintain a small frontal profile and also allows supporting circuitry to be placed in the manner as shown in Pelchy, *i.e.*, two parallel circuit boards placed in perpendicular arrangement with the imaging device 20. There is no suggestion or

teaching in Pelchy, et al. that any circuitry whatsoever should be placed co-planar with the CCD imaging device 20. In fact, even if a CCD imaging device of Pelchy could be configured to accept control circuitry which is co-planar with its pixel array, such an arrangement would further teach away from the use of the CCD imaging device in an endoscope application as such a co-planar arrangement would greatly increase the profile of the imaging device making it impossible to use for introduction in the body. Accordingly, the need for a small frontal profile is exactly why the board 115 of the prior art, and boards 27 and 28 of Pelchy, et al. are placed directly behind and perpendicular to the CCD imager 20. The *Laser Focus* article at page 3, discloses the use of timing and control circuitry which is found co-planar with the imaging elements "To overcome the lower biasing requirements and to improve noise characteristics of passive pixels, photogates or photodiodes feature an amplifier at the end of each row or column, along with FPN correction circuitry." Substituting the imager structure of the *Laser Focus* article in Pelchy, et al. would defeat the sole purpose stated in Pelchy, et al. of providing tape automated bonding to connect circuitry elements. In other words, the substitution of the CMOS imaging device as disclosed in the article would expressly defeat the purpose of having tape automated bonding because certain control circuitry would be found co-planar with the pixel array and would need no special type of bonding or connecting means.

Stated in yet another way, the combination of Pelchy, et al. with the imaging device disclosed in the *Laser Focus* article would clearly violate the case law set forth above which guides how references may be combined to set forth a proper obviousness rejection. Pelchy, et al. expressly teaches away from placing any circuitry on the same plane with the imager because

the sole purpose of providing tape automated bonding is to allow circuitry to be remoted from the imager plane. As discussed above, CCD devices have some advantages over CMOS devices; therefore, substituting a CMOS imaging device would actually detract from the stated purposes found in Pelchy, et al.

The Examiner argues that CMOS technology in general provides certain advantages (low power consumption) and, therefore, this provides the motivation to combine the references. In harmony with *Bausch & Lomb, Inc.*, the references must be considered as a whole, and portions arguing against or teaching away from the claimed invention must be considered. The express and clear purpose stated in Pelchy, et al. for providing tape automated bonding is defeated if a CMOS based imager is used within the structure of Pelchy, et al. In accordance with *In re Ratti*, the proposed modification or combination of the references changes the basic principle of operation of Pelchy, et al. That is, providing timing and control circuitry which is co-planar with the image sensor in Pelchy, et al. eliminates the need for utilizing a tape automated bonding process. Furthermore, in accordance with *In re Gordon*, the proposed modification to the Pelchy, et al. reference would clearly render the invention being modified unsatisfactory for its intended purpose. The incorporation of timing and control circuitry co-planar with the image sensor would completely negate the need for tape automated bonding to include the circuit boards 27 and 28 in Pelchy, et al. The Examiner's argument that minimizing power consumption provides the motivation to combine the references ignores the express teachings by both of the references as to why their combination is improper. It is well known that CMOS devices use



less power than CCD devices; however, this clearly does not provide the necessary motivation to combine the references.

Claims 1 and 6 require an array of CMOS pixels and circuitry means on said first plane and coupled to said array of CMOS pixels for timing and control of said array of CMOS pixels. As discussed above, Pelchy in combination with the *Laser Focus* article does not meet this limitation.

Independent Claims 1 and 14 have been amended to require that the video processor board handles all of the processing of the image signal so that the post-video signal is made for direct reception by a video device. Neither Pelchy or any references combined with Pelchy teach this limitation that a video processor board lying in a second plane spaced from the CMOS imager performs all the image signal processing. Pelchy clearly requires the external processor 13 (column 3, lines 10-15). Therefore, it is irrelevant whether or not Pelchy is combinable with the *Laser Focus* article because neither of these references meet this limitation. Therefore, Claims 1 and 14 should be allowed.

Claim 24 is allowable for the same reasons as set forth above with respect to Claim 1. Claim 24 requires an array of CMOS pixels and circuitry means for timing and control of the CMOS pixels to lie on a first plane. Pelchy and the *Laser Focus* article are not combinable to meet this limitation.

Claims 11-13 and 30-32 were rejected under 35 U.S.C. §103 as being unpatentable over Pelchy in view of *Laser Focus* and further in view of Danna, et al. In this rejection, the Examiner stated that Pelchy failed to disclose the parallel positioning of the circuit boards, and that Danna disclosed such a parallel arrangement. Pelchy at column 2, lines 66-67, and column 3, lines 1-5, discusses the problem being overcome by Pelchy



which is to shorten the length of the circuitry attached to the imager by creating two boards in perpendicular arrangement behind the imager. To rearrange the circuit boards 27 and 28 in Pelchy in a parallel arrangement with the imager 20 would expressly defeat the purpose of the Pelchy reference which is provide to a modified tape automated bonding invention. As best seen in Figure 2 of Pelchy, rearranging the boards 27 and 28 in parallel arrangement behind the imager 20 would actually greatly increase the width/profile of the imager. Also, it is clear that the tape automated bonding structure disclosed in Pelchy would be greatly modified as leads 24 and protective strips 31 would at least have to be greatly lengthened, if not having to be totally redesigned. Therefore, the use of any arrangement of parallel circuit boards with the TAB imager of Pelchy would clearly defeat the purpose of having tape automated bonding. It is also brought to the Examiner's attention that Danna also discloses a CCD-type imager which completely isolates the imager 25 from any processing circuitry. Therefore, this is further evidence that even in the construction of endoscopes designed for compact size, the idea of incorporating timing and control circuitry co-planar with an imaging element is not obvious. Claims 11 and 30 both require a circuit board to be longitudinally aligned with an array of CMOS pixels, and further that the circuit board lie in a second plane which is off-set from and substantially parallel to the first plane on which the CMOS pixels lie. This limitation is clearly not taught by a combination of any other references. Therefore, the rejection of Claims 11-13 and 30-32 should be withdrawn.

Claims 4-5 and 23 were rejected under 35 U.S.C. §103 as being unpatentable over Pelchy in view of the 6/97 *Laser Focus* article and further in view of Danna et al. Claims 4 and 5 depend directly and

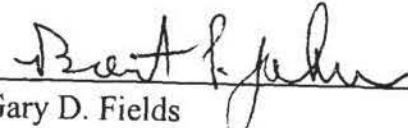
indirectly, respectively, from Claim 1, and Claim 23 depends directly from Claim 14. For the same reasons as set forth above with respect to independent Claims 1 and 14, Claims 4-5 and 23 are allowable because each of these claims add additional limitations not overcome by the prior art of record. Therefore, the rejection for Claims 4-5 and 23 should be withdrawn.

Claims 22 and 29 were rejected under 35 U.S.C. §103 as being unpatentable over Pelchy in view of the 6/97 *Laser Focus* article and further in view of Steinberg. Claim 22 depends directly from Claim 14, and Claim 29 depends directly from Claim 24. For the same reasons as set forth above with respect to Claims 14 and 24, Claims 22 and 29 are allowable because each of these claims again add additional limitations which are not overcome by the prior art of record. Therefore, this rejection should also be withdrawn.

A sincere effort has been made to place this application in a condition for allowance; therefore, such favorable action is earnestly solicited.

Respectfully submitted,

FIELDS & JOHNSON, P.C.

  
\_\_\_\_\_  
Gary D. Fields  
Brent P. Johnson  
Attorneys for Applicant  
8480 East Orchard Road, Suite 5600  
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(303) 689-9100

Date: 9/1/99



**UNITED STATES DEPARTMENT OF COMMERCE  
Patent and Trademark Office**

Address: COMMISSIONER OF PATENTS AND TRADEMARKS  
Washington, D.C. 20231

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
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09/175,685 10/20/98 ADAIR

E F97.13-CIPW

BRENT P JOHNSON  
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ENGLEWOOD CO 80111

LM02/1104

EXAMINER

BAQ, A

ART UNIT

PAPER NUMBER

2713  
DATE MAILED:

11/04/99

**Please find below and/or attached an Office communication concerning this application or proceeding.**

**Commissioner of Patents and Trademarks**

# **-Office Action Summary**

Application No.  
**09/175,685**

Applicant(s)

**Adair et al.**

Examiner

**Anand Rao**

Group Art Unit  
**2713**



☒ Responsive to communication(s) filed on Sep 1, 1999

☐ This action is **FINAL**.

☐ Since this application is in condition for allowance except for formal matters, **prosecution as to the merits is closed** in accordance with the practice under *Ex parte Quayle*, 35 C.D. 11; 453 O.G. 213.

A shortened statutory period for response to this action is set to expire 3 month(s), or thirty days, whichever is longer, from the mailing date of this communication. Failure to respond within the period for response will cause the application to become abandoned. (35 U.S.C. § 133). Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

## **Disposition of Claim**

☒ Claim(s) 1-8 and 11-32 is/are pending in the application.

Of the above, claim(s) \_\_\_\_\_ is/are withdrawn from consideration.

☒ Claim(s) 14-29 is/are allowed.

☒ Claim(s) 1-8, 11-13, and 30-32 is/are rejected.

☐ Claim(s) \_\_\_\_\_ is/are objected to.

☐ Claims \_\_\_\_\_ are subject to restriction or election requirement.

## **Application Papers**

☐ See the attached Notice of Draftsperson's Patent Drawing Review, PTO-948.

☐ The drawing(s) filed on \_\_\_\_\_ is/are objected to by the Examiner.

☐ The proposed drawing correction, filed on \_\_\_\_\_ is ☐ approved ☐ disapproved.

☐ The specification is objected to by the Examiner.

☐ The oath or declaration is objected to by the Examiner.

## **Priority under 35 U.S.C. § 119**

☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

☐ All ☐ Some\* ☒ None of the CERTIFIED copies of the priority documents have been  
☐ received.

☐ received in Application No. (Series Code/Serial Number) \_\_\_\_\_

☐ received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

\*Certified copies not received: \_\_\_\_\_

☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

## **Attachment(s)**

☒ Notice of References Cited, PTO-892

☐ Information Disclosure Statement(s), PTO-1449, Paper No(s). \_\_\_\_\_

☐ Interview Summary, PTO-413

☐ Notice of Draftsperson's Patent Drawing Review, PTO-948

☐ Notice of Informal Patent Application, PTO-152

--- SEE OFFICE ACTION ON THE FOLLOWING PAGES ---

Art Unit: 2713

## DETAILED ACTION

### *Response to Amendment*

1. Applicant's arguments with respect to claims 1-8, 11-13 and 30-32 as put forth in Paper 12 on 9/1/99 have been considered but are moot in view of the new ground(s) of rejection.

### *Claim Rejections - 35 USC § 103*

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1-8, 11-13, and 30-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lenhardt et al., (hereinafter referred to as "Lenhardt") in view of the 6/97 Laser Focus article entitled "Imaging options expand with CMOS technology" (hereinafter referred to as "Laser Focus").

Lenhardt discloses a reduced area imaging device (Lenhardt: figure 2), comprising : an image sensor lying in a first plane and including an array of pixels for receiving images thereon, said image sensor producing a pre-video signal; (Lenhardt: column 6, lines 39-45), a pre-video conductor for transmitting said pre-video signal from said first circuit board to a second circuit board (Lenhardt: column 6, lines 45-50); a first circuit board lying in second plane and longitudinally aligned with said image sensor, said first circuit board being connected to said pre-

Art Unit: 2713

video conductor at said second end thereof, said first circuit board including circuitry means for converting said pre-video signal to a post-video signal for reception by a stand video device signal for direct reception by a standard video device (Lenhardt: column 6, lines 27-35); and a power supply device coupled with said image sensor for driving said array of pixels, and electrically coupled to said first circuit board for driving said circuit board (Lenhardt: column 4, lines 17-25), as specified in claim 1. However, Lenhardt fails to disclose the that the image sensor further includes timing and control circuitry means on said first plane and coupled to said pixel array such as a CMOS imager (Lenhardt: column 6, lines 39-57). The Laser Focus article discloses that the use of a passive CMOS image sensor timing and control circuitry at each CMOS pixel (Laser Focus: third page, right most column, lines 32-60) is preferable to using a CCD because the standard CCD imagers as contained by the original Lenhardt apparatus waste more power (Laser Focus: second page, leftmost column, lines 35-50). Accordingly, given the Laser Focus article's teaching of advantageously using a passive CMOS image sensor, it would have been obvious for one of ordinary skill in the art to modify the Lenhardt apparatus by incorporating the Laser Focus article's disclosed passive CMOS imager for the standard Lenhardt imager (Lenhardt: figure 2, element 20) in order to minimize power consumption. The Lenhardt apparatus, as modified with the inclusion of the Laser Focus's passive CMOS imager which has timing and control circuitry at each pixel site, has all of the features of claim 1.

Regarding claim 2, the Lenhardt apparatus, as modified with the inclusion of the Laser Focus's passive CMOS imager which has timing and control circuitry at each pixel site, would

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have the image sensor defining a profile area (Lenhardt: figure 2, element 4), and said first circuit board being positioned not to extend beyond said profile area (Lenhardt: column 5, lines 10-23), as specified.

Regarding claim 3, the Lenhardt apparatus, as modified with the inclusion of the Laser Focus's passive CMOS imager which has timing and control circuitry at each pixel site, has a second circuit board electronically coupled with said first circuit board and said image sensor for enhancing said pre-video signal as specified, and second circuit board being longitudinally aligned with said first circuit board and said image sensor so as to not extend substantially beyond said profile area (Lenhardt: column 6, lines 45-57), as specified.

Lenhardt discloses a reduced area imaging device (Lenhardt: figure 4), comprising : an image sensor lying in a first plane and including an array of pixels for receiving images thereon, said image sensor producing a pre-video signal; (Lenhardt: column 6, lines 39-41) a pre-video conductor for transmitting said pre-video signal from said first circuit board to a second circuit board (Lenhardt: column 6, lines 45-50); a control box remote from said image sensor, said control box including circuitry means for receiving said pre-video signal from the image sensor as specified (Lenhardt: column 6, lines 30-32); and a power supply device coupled with said image sensor for driving said array of pixels, and electrically coupled to said first circuit board for driving said circuit board (Lenhardt: column 6, lines 38-42), as specified in claim 6. However, Lenhardt fails to disclose the that the image sensor further includes timing and control circuitry means on said first plane and coupled to said pixel array such as a CMOS imager (Lenhardt:



Art Unit: 2713

column 3, lines 45-50), even though the reference recognizes that the use of a TAB imager could be also apply CMOS based imager (Lenhardt: column 1, lines 7-10). The Laser Focus article discloses that the use of a passive CMOS image sensor timing and control circuitry at each CMOS pixel (Laser Focus: third page, right most column, lines 32-60) is preferable to using a CCD because the standard CCD imagers as contained by the original Lenhardt endoscope waste more power (Laser Focus: second page, leftmost column, lines 35-50). Accordingly, given the Laser Focus article's teaching of advantageously using a passive CMOS image sensor, it would have been obvious for one of ordinary skill in the art to modify the Lenhardt apparatus by incorporating the Laser Focus article's disclosed passive CMOS imager for the standard Lenhardt imager (Lenhardt: figure 2, element 20) in order to minimize power consumption. The Lenhardt apparatus, as modified with the inclusion of the Laser Focus's passive CMOS imager which has timing and control circuitry at each pixel site, has all of the features of claim 6.

Regarding claim 7, the Lenhardt apparatus, as modified with the inclusion of the Laser Focus's passive CMOS imager which has timing and control circuitry at each pixel site, has a supplementary circuit board electronically coupled with said first circuit board and said image sensor for enhancing said pre-video signal as specified (Lenhardt: figure 2, elements 21), as specified.

Regarding claim 8, the Lenhardt apparatus, as modified with the inclusion of the Laser Focus's passive CMOS imager which has timing and control circuitry at each pixel site, has an

Art Unit: 2713

array of passive CMOS pixels which includes a photo diode and access transistor pair (Laser Focus: page 3, rightmost column, lines 28-38), as specified.

Regarding claim 9, the Lenhardt apparatus, as modified with the inclusion of the Laser Focus's passive CMOS imager which has timing and control circuitry at each pixel site, has an array of passive CMOS pixels which includes a photo diode and access transistor pair (Laser Focus: page 3, rightmost column, lines 28-38), as specified.

Regarding claim 10, the Lenhardt apparatus, as modified with the inclusion of the Laser Focus's active CMOS imager which has timing and control circuitry at each pixel site, has an amplifier for each individual pixel (Laser Focus: page 2, rightmost column, lines 4-9), as in the claim.

Lenhardt discloses a reduced area imaging device (Lenhardt: figure 4), comprising : an image sensor lying in a first plane and including an array of pixels for receiving images thereon (Lenhardt: column 5, lines 10-20); a circuit board longitudinally aligned with and lying in a second plane and electrically coupled to with said image sensor, said first circuit board including circuitry means for converting said pre-video signal to a post-video signal for direct reception by a stand video device signal for reception by a standard video device (Lenhardt: column 6, lines 27-35); and a power supply device coupled with said image sensor for driving said array of pixels, and electrically coupled to said first circuit board for driving said circuit board (Lenhardt: column 6, lines 38-47), and that the image sensor is parallel to the first circuit board (Lenhardt: column 6, lines 49-51)as specified in claim 11. However, Lenhardt fails to disclose the that the image sensor

Art Unit: 2713

further includes timing and control circuitry means on said first plane and coupled to said pixel array such as a CMOS imager (Lenhardt: column 3, lines 45-50), even though the reference recognizes that the use of a TAB imager could be also apply CMOS based imager (Lenhardt: column 1, lines 7-10). The Laser Focus article discloses that the use of a passive CMOS image sensor timing and control circuitry at each CMOS pixel (Laser Focus: third page, right most column, lines 32-60) is preferable to using a CCD because the standard CCD imagers as contained by the original Lenhardt endoscope waste more power (Laser Focus: second page, leftmost column, lines 35-50). Accordingly, given the Laser Focus article's teaching of advantageously using a passive CMOS image sensor, it would have been obvious for one of ordinary skill in the art to modify the Lenhardt apparatus by incorporating the Laser Focus article's disclosed passive CMOS imager for the standard Lenhardt imager (Lenhardt: figure 2, element 20) in order to minimize power consumption. The Lenhardt apparatus, as modified with the inclusion of the Laser Focus's passive CMOS imager which has timing and control circuitry at each pixel site, has all of the features of the features of claim 11.

Regarding claim 12, the Lenhardt-Laser-Focus apparatus, has an array of passive CMOS pixels which includes a photo diode and access transistor pair (Laser Focus: third page, rightmost column, lines 28-38), as specified.

Regarding claim 13, the Lenhardt-Laser-Focus apparatus has a supplementary circuit board electronically coupled with said first circuit board and said image sensor for enhancing said pre-video signal as specified (Lenhardt: column 6, lines 45-57; column 7, lines 1-3), as specified.

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Lenhardt discloses a reduced area imaging device (Lenhardt: figure 4), comprising: an image sensor lying in a first plane and including an array of pixels for receiving images thereon (Lenhardt: column 5, lines 10-20); a circuit board longitudinally aligned with and second plane and electrically coupled to with said image sensor, said first circuit board including circuitry means for converting said pre-video signal to a post-video signal for reception by a stand video device signal for reception by a standard video device (Lenhardt: figure 2, element 21); a control box remote from said image sensor, said control box including circuitry means for receiving said pre-video signal from the image sensor as specified (Lenhardt: column 6, lines 25-35); and a power supply device coupled with said image sensor for driving said array of pixels, and electrically coupled to said first circuit board for driving said circuit board (Lenhardt: column 6, lines 39-41) and that the circuit board is substantially parallel to the image sensor plane (Lenhardt: column 6, lines 45-57), as specified in claim 30. However, Lenhardt fails to disclose the that the image sensor is a CMOS image and further includes timing and control circuitry means thereon, even though the reference recognizes that the use of a TAB imager could be also apply CMOS based imager (Lenhardt: column 1, lines 7-10). The Laser Focus article discloses that the use of a active CMOS image sensor timing and control circuitry at each CMOS pixel (Laser Focus: second page, rightmost column, lines 4-8) is preferable to using a CCD because the standard CCD imagers as contained by the original Lenhardt endoscope waste more power (Laser Focus: second page, leftmost column, lines 35-50). Accordingly, given the Laser Focus article's teaching of advantageously using a active CMOS image sensor, it would have been obvious for one of

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ordinary skill in the art to modify the Lenhardt apparatus by incorporating the Laser Focus article's disclosed active CMOS imager for the standard Lenhardt imager (Lenhardt: figure 2, element 20) in order to minimize power consumption. The Lenhardt apparatus, as modified with the inclusion of the Laser Focus's active CMOS imager which has timing and control circuitry at each pixel site, has all of the features of claim 30.

Regarding claim 31, the Lenhardt-Laser-Focus apparatus, has an array of passive CMOS pixels which includes a photo diode and access transistor pair (Laser Focus: third page, rightmost column, lines 28-38), as specified.

Regarding claim 32, Lenhardt-Laser-Focus apparatus, has an amplifier for each individual pixel (Laser Focus: second page, rightmost column, lines 4-9), as in the claim.

*Allowable Subject Matter*

4. Claims 14-29 are allowed.

Independent claims 14 and 24 are allowed because these claims recite the arrangement of the use of an endoscope with the CMOS pixels array with resident timing and control circuitry, and the second longitudinally aligned video processing board as in the claims. Dependent claims 15-23, and 25-29 are allowed for the reasons as indicated for the independent claims. Accordingly, if rejected claims 1-13 and 30-32 are canceled, the application would be placed in a condition for allowance.

Serial Number: 09/175,685

Page 10

Art Unit: 2713

*Conclusion*

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Anand S. Rao whose telephone number is (703)-305-4813 .

asr

October 19, 1999

ANDY RAO  
PRIMARY EXAMINER  


# **Notice of References Cited**

Application No.  
09/175,685

Applicant(s)

Adair et al.

Examiner

Anand Rao

Group Art Unit  
2713

Page 1 of 1

## **U.S. PATENT DOCUMENTS**

	DOCUMENT NO.	DATE	NAME	CLASS	SUBCLASS
A	5,453,785	9/26/95	Lenhardt et al.	348	357
B					
C					
D					
E					
F					
G					
H					
I					
J					
K					
L					
M					

## **FOREIGN PATENT DOCUMENTS**

	DOCUMENT NO.	DATE	COUNTRY	NAME	CLASS	SUBCLASS
N						
O						
P						
Q						
R						
S						
T						

## **NON-PATENT DOCUMENTS**

DOCUMENT (Including Author, Title, Source, and Pertinent Pages)

DATE

	DOCUMENT (Including Author, Title, Source, and Pertinent Pages)	DATE
U		
V		
W		
X		



NOV-08-99 MON 10:24 AM FIELDS & JOHNSON, P.C.

FAX NO. 3036899250

P.01

**FIELDS & JOHNSON** **OFFICIAL** **FAX RECEIVED**  
*A Professional Corporation*

NOV 8 1999

Group 2700

ATTORNEYS AT LAW  
PATENTS - TRADEMARKS - COPYRIGHTS - LITIGATION

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8480 EAST ORCHARD ROAD, SUITE 5600  
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GARY D. FIELDS  
BRENT P. JOHNSON

### FACSIMILE COVER SHEET

DATE: November 8, 1999  
TO: Examiner Anand S. Rao (Andy)  
ENTITY: U.S. Patent and Trademark Office, Art Unit 2713  
FAX NO.: 705-308-5359  
FROM: Brent P. Johnson  
SUBJECT: Amendment to U.S. Continuation-in-Part Patent Application Serial No.  
09/175,685 Entitled "Reduced Area Imaging Devices" to Edwin L. Adair,  
et al. filed 10/20/98; Docket No. F97.13 CIP 2  
NO. OF PAGES (including cover page): 11

### REMARKS

See enclosed Amendment

The original of the transmitted document(s) will be sent:  
☒ By Fax Only ☐ First Class Mail ☐ Overnight

### CONFIDENTIAL COMMUNICATION

The information contained in or attached to this FAX message is intended only for the confidential use of the individual(s) named above. If you are not the named recipient or an agent responsible for delivering it to the named recipient, you are hereby notified that you have received this document in error and that review, dissemination or copying of this communication is prohibited. If you have received this communication in error, please notify us immediately by telephone and return the attached documents to us by mail. THANK YOU.

**OFFICIAL FAX RECEIVED**

NOV 8 1999

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

STOUD 2700

In Re the Continuation in Part  
Application of) AMENDMENT

) Examiner: A. Rao

Edwin L. Adair, Jeffrey L. Adair,  
Randall S. Adair

) Art Unit: 2713

Serial No.: 09/175,685

) VIA FACSIMILE TRANSMISSION  
) 703-308-5359

Filed: October 20, 1998

) CERTIFICATE OF FACSIMILE TRANSMISSIONFor: "Reduced Area Imaging  
Devices"

) I hereby certify that this paper for reg./ser. no.

) 09/175,685 is being facsimile transmitted to thePatent and Trademark Office fax number 703 308 5359  
on the date shown below.Assistant Commissioner for Patents  
Washington, D.C. 20231KATHERINE L. GONCALVES

Type or print name of person signing certificate

Sir:

Katherine L. Goncalves 11/8/99  
Signature Date

This amendment is responsive to the Office Action dated  
October 19, 1999 which was faxed to the applicant on November 3, 1999,  
the above-identified application being amended as follows:

**IN THE CLAIMS:**

Amend Claim 1 as follows:

1. (Twice amended) A reduced area imaging device  
comprising:

an imager sensor lying in a first plane and including an array  
of CMOS pixels for receiving images thereon, said image sensor further  
5 including circuitry means on said first plane and coupled to said array of  
CMOS pixels for timing and control of said array of CMOS pixels, said  
image sensor producing a pre-video signal;

a pre-video conductor for transmitting said pre-video signal,  
said pre-video conductor having first and second ends, said first end  
10 communicating with said image sensor;

E1  
cont

2

E1  
Concl

15 a first circuit board lying in a second plane and longitudinally aligned with said image sensor, said first circuit board being connected to said pre-video conductor at said second end thereof, said first circuit board including circuitry means for converting said pre-video signal to a post-video signal for direct reception by a standard video device; [and]

a power supply electrically coupled with said image sensor for driving said array of pixels and said timing and control means, and electrically coupled to said first circuit board for driving said circuit board[.] ; and

20 a non-removable lens integral with said imaging device for focusing images on said image sensor.

---

Amend Claim 6 as follows:

6. (Twice amended) A reduced area imaging device comprising:

E2  
cont

5 an image sensor lying in a first plane and including an array of CMOS pixels for receiving images thereon, said image sensor further including circuitry means on said first plane and coupled to said array of CMOS pixels for timing and control of said array of CMOS pixels, said image sensor producing a pre-video signal;

10 a control box remote from said image sensor, said control box including circuitry means for receiving said pre-video signal from said image sensor, and for converting said pre-video signal to a post-video signal which may be received by a standard video device; [and]

a power supply coupled to said control box and said image sensor for providing power thereto[.] ; and

3

E2  
concl

a non-removable lens integral with said imaging device for  
focusing images on said image sensor.

Amend Claim 11 as follows:

9. ~~11~~ (Twice amended) A reduced area imaging device  
comprising:

an array of CMOS pixels defining a profile area and lying in  
a first plane, said array of CMOS pixels for receiving images thereon;

5 a circuit board longitudinally aligned with and electrically  
coupled to said array of CMOS pixels, said circuit board lying in a second  
plane which is offset from said first plane and substantially parallel to said  
first plane, said circuit board including circuitry means for timing and  
control of said array of CMOS pixels, said timing and control means  
10 producing a pre-video signal, said circuit board further including circuitry  
means for receiving said pre-video signal from said timing and control  
means and converting said pre-video signal to a post-video output signal  
for direct reception by a video device; [and]

E3  
concl

15 a power supply electrically coupled to said array of said  
CMOS pixels and said circuit board[.] : and

a non-removable lens integral with said imaging device for  
focusing images on said image sensor.

Amend Claim 30 as follows:

28. ~~30~~ (Amended) A reduced area imaging device comprising:

an array of CMOS pixels defining a profile area and lying in  
a first plane, said array of said CMOS pixels for receiving images thereon;

E4  
cont

4

5 a circuit board longitudinally aligned with and electrically  
coupled to said array of CMOS pixels, said circuit board lying in a second  
plane which is offset from said first plane and substantially parallel to said  
first plane, said circuit board including timing and control means for  
controlling the release of information from said array of CMOS pixels, said  
timing and control means producing a pre-video signal;

10 a control box remote from said array of said CMOS pixels  
and said circuit board, said control box including circuitry means for  
receiving said pre-video signal, and for converting said pre-video signal to  
a post-video signal which may be received by a standard video device;  
[and]

15 a power supply coupled to said control box, said array of  
CMOS pixels and said timing and control means for providing power  
thereto[.] and

a non-removable lens integral with said imaging device for  
focusing images on said array of CMOS pixels.

#### REMARKS

Pursuant to the telephonic interview with the Examiner on  
November 4, 1999, the applicant has amended each of the remaining  
independent claims, namely, Claims 1, 6, 11 and 30, in order to overcome  
the newly cited reference to Lenhardt, U.S. Patent No. 5,453, 785. Each of  
the independent claims has been amended to require a non-removable lens  
which is integral with the imaging device. This limitation finds clear  
antecedent support in the specification at page 12, lines 12-17. The term  
"non-removable" as used in the claims shall mean that the lens does not  
incorporate the use of any connection means which allows the lens to be

readily and normally removed. It should also be understood that the term "non-removable lens" as now found in Claims 1, 6, 11 and 30 does not mean that the lens may not be manipulated for axial adjustment for focusing. Thus, the term "non-removable" means that there is a continual attachment of the lens to the imaging device, albeit that the attachment could be made in such a manner that the lens could be moved with respect to the imaging sensor.

In Lenhardt, the invention disclosed therein requires that the lens system be physically removed from the rest of the measurement camera. Column 5, lines 5-10, explain that a bayonet connection comprised of a bayonet flange 10 on the front side of the measuring head 3 (Figure 3) and a retaining ring of 13 on the connecting side of the objective 1 (Figure 4) are utilized to enable replacement of the objective 1. Column 6, lines 56-end, explain that different objectives 1 can be used which can be matched to the respective measuring goal and respectively substituted for one another depending upon the measuring results actually to be accomplished. In other words, in order to achieve the different measuring goals, the objective 1, which contains the plurality of lenses, must be removable. Accordingly, each of the remaining independent claims now clearly distinguishes over the teachings in Lenhardt.

It is brought to the Examiner's attention that a Second Supplementary Preliminary Amendment was filed in connection with this application on July 29, 1999. Enclosed herewith is this Amendment which includes amendments to Claim 24 and the addition of dependent Claims 33 and 34. The instant Office Action did not indicate the presence of new Claims 33 and 34.

6

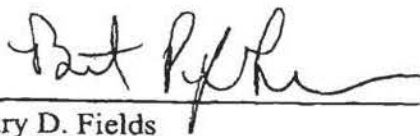
Also enclosed is a copy of the return postcard indicating receipt by the Patent Office on August 4, 1999. Claims 33 and 34 depend from Claim 24, and simply add other limitations which are not disclosed by the prior art references of record. Therefore, it is respectfully requested that the Examiner also indicate the existence of Claims 33 and 34.

Applicant gratefully acknowledges the allowability of Claims 14-29.

A sincere effort has been made to place this application in a condition for allowance; therefore, such favorable action is earnestly solicited.

Respectfully submitted,

FIELDS & JOHNSON, P.C.



Gary D. Fields  
Brent P. Johnson  
Attorneys for Applicant  
8480 East Orchard Road  
Englewood, CO 80111

Date: \_\_\_\_\_

11/8/99



RECEIVED

NOV 8 1999

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE Group 2700

In Re the Continuation in Part ) SECOND SUPPLEMENTAL  
Application of ) PRELIMINARY  
) AMENDMENT

Edwin L. Adair, Jeffrey L. Adair, )  
Randall S. Adair )

Examiner: A. Rao

Serial No.: 09/175,685 )

Art Unit: 2713

Filed: October 20, 1998 )

For: "Reduced Area Imaging  
Devices"

I hereby certify that this correspondence is being  
deposited with the United States Postal Service as  
first class mail in an envelope addressed to:  
Assistant Commissioner for Patents, Washington,

D.C. 20231, on

7/29/99

(Date of Deposit)

*Katherine L. Gonzalez*  
Name of applicant, assignee, or Registered Rep.

Assistant Commissioner for Patents  
Washington, D.C. 20231

Sir:

Please amend the above-identified application as follows:

IN THE CLAIMS:

22. 24. (Amended) An endoscope comprising:

a tubular portion including a central passageway extending  
therethrough, a proximal end and a distal end;

5 a CMOS image sensor positioned at said distal end of said  
tubular portion for receiving images of a surgical site, said CMOS imager  
defined by an array of CMOS pixels and [wherein individual pixels within  
said array of said CMOS pixels each include an amplifier], said CMOS  
imager lying in a first plane;

10 circuitry means for timing and control of said CMOS image  
sensor placed adjacent to said CMOS image sensor on said first plane;

a control box remote from said tubular portion and coupled to  
said CMOS image sensor, said control box including circuitry means for  
receiving a pre-video signal from said CMOS image sensor, and for

F1  
cont

2

F1  
concl 15 converting said pre-video signal to a post-video signal which may be  
received by a standard video device; and  
a power supply coupled to said control box and said CMOS  
image sensor for providing power thereto.

---

Add the following new claims:

---

31. <sup>33</sup> An endoscope, as claimed in claim <sup>22</sup> 24, wherein:  
individual pixels within said array of CMOS pixels each  
include an amplifier.

F2  
concl <sup>32</sup> 34. An endoscope, as claimed in claim <sup>22</sup> 24, wherein:  
said array of CMOS pixels includes a plurality of passive  
CMOS pixels, and wherein individual passive CMOS pixels of said  
plurality of passive CMOS pixels each include a photo diode for producing  
photo electrically generated signals, and an access transistor  
communicating with said photo diode to control the release of said photo  
electrically generated signals.

---

#### REMARKS

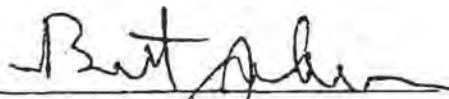
By the foregoing, Claim 24 has been amended, and new Claims 33  
and 34 have been added. As a review of the claims in this application,  
Claims 1-7 were filed originally with the application, Claims 8-29 were  
added in the Preliminary Amendment filed on March 8, 1999, and Claims  
30-32 were added in a first Supplementary Preliminary Amendment filed  
on March 24, 1999. Enclosed herewith is a check in the amount of \$18.00

3

to cover the additional fees for new Claims 33 and 34. Any shortfall may be charged to Deposit Account No. 06-0778.

Respectfully submitted,

FIELDS & JOHNSON, P.C.



Gary D. Fields  
Brent P. Johnson  
8480 East Orchard Road, Suite 5600  
Englewood, CO 80111  
(303) 689-9100

Date:

7/29/99

July 29, 1999

RE: U.S. Continuation-in-Part Patent Application Serial No. 09/175,685 Entitled "Reduced Area Imaging Devices" to Edwin L. Adair, et al.; Docket No. F97-14 C122

Enclosed herewith for filing:

- (x) Second Supplemental Preliminary Amendment
- (x) Transmittal Form
- (x) Fee Transmittal Form (1 original & 1 copy)
- (x) Check for \$18.00
- (x) Return postcard
- (x) Patent Application Fee Determination Record

/klg

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AUG 09 1999



UNITED STATES DEPARTMENT OF COMMERCE  
Patent and Trademark Office

Address: COMMISSIONER OF PATENTS AND TRADEMARKS  
Washington, D.C. 20231

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
097175,685	10/20/98	ADAIR	F97.13-CIP2

BRENT P JOHNSON  
FIELDS & JOHNSON  
SUITE 5600  
8480 EAST ORCHARD ROAD  
ENGLEWOOD CO 80111

LM61/1122

EXAMINER
RAD, A

ART UNIT	PAPER NUMBER
2713	

DATE MAILED: 11/22/99

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

# Notice of Allowability

Application No.

09/175,685

Applicant(s)

Adair et al.

Examiner

Anand Rao

Group Art Unit

2713

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance and Issue Fee Due or other appropriate communication will be mailed in due course.

☒ This communication is responsive to the Amendments filed on 11/8/99 as Papers 13 and 14

☒ The allowed claim(s) is/are 1-8, 11-34 (respectfully renumbered as claims 1-32)

☒ The drawings filed on Oct 20, 1998 are acceptable.

☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

☐ All ☐ Some\* ☒ None of the CERTIFIED copies of the priority documents have been

☐ received.

☐ received in Application No. (Series Code/Serial Number) \_\_\_\_\_

☐ received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

\*Certified copies not received: \_\_\_\_\_

☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

A SHORTENED STATUTORY PERIOD FOR RESPONSE to comply with the requirements noted below is set to EXPIRE **THREE MONTHS** FROM THE "DATE MAILED" of this Office action. Failure to timely comply will result in ABANDONMENT of this application. Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

☐ Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL APPLICATION, PTO-152, which discloses that the oath or declaration is deficient. A SUBSTITUTE OATH OR DECLARATION IS REQUIRED.

☐ Applicant MUST submit NEW FORMAL DRAWINGS

☐ because the originally filed drawings were declared by applicant to be informal.

☐ including changes required by the Notice of Draftsperson's Patent Drawing Review, PTO-948, attached hereto or to Paper No. \_\_\_\_\_.

☐ including changes required by the proposed drawing correction filed on \_\_\_\_\_, which has been approved by the examiner.

☐ including changes required by the attached Examiner's Amendment/Comment.

Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the reverse side of the drawings. The drawings should be filed as a separate paper with a transmittal letter addressed to the Official Draftsperson.

☐ Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Any response to this letter should include, in the upper right hand corner, the APPLICATION NUMBER (SERIES CODE/SERIAL NUMBER). If applicant has received a Notice of Allowance and Issue Fee Due, the ISSUE BATCH NUMBER and DATE of the NOTICE OF ALLOWANCE should also be included.

## Attachment(s)

☐ Notice of References Cited, PTO-892

☐ Information Disclosure Statement(s), PTO-1449, Paper No(s). \_\_\_\_\_

☐ Notice of Draftsperson's Patent Drawing Review, PTO-948

☐ Notice of Informal Patent Application, PTO-152

☐ Interview Summary, PTO-413

☐ Examiner's Amendment/Comment

☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material

☒ Examiner's Statement of Reasons for Allowance

ANDY RAO  
PRIMARY EXAMINER

Art Unit: 2713

*Allowable Subject Matter*

1. Claims 1-8, 11-34 are allowed.

Independent claims 14 and 24 are allowed because these claims recite the arrangement of the use of an endoscope with the CMOS pixels array with resident timing and control circuitry, and the second longitudinally aligned video processing board as in the claims. Dependent claims 15-23, 25-29, and 33-34 are allowed for the reasons as indicated for the independent claims. Independent claims 1, 6, 11, and 30 are allowed because these claims recite the arrangement of the use of a reduced area image device with the CMOS pixels array with resident timing and control circuitry, and the second longitudinally aligned video processing board, and further stipulate a non-removable lens integral with said imaging device, as in the claims. Dependent claims 2-8, 12-13, 31-32 are allowed for the reasons concerning claims 1, 6, 11, and 30.

*Conclusion*

2. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Anand S. Rao whose telephone number is (703)-305-4813 .

asr  
October 19, 1999

ANDY RAO  
PRIMARY EXAMINER





UNITED STATES DEPARTMENT OF COMMERCE  
Patent and Trademark Office

NOTICE OF ALLOWANCE AND ISSUE FEE DUE

LM61/J122

BRENT P JOHNSON  
FIELDS & JOHNSON  
SUITE 5600  
8480 EAST ORCHARD ROAD  
ENGLEWOOD CO 80111

APPLICATION NO.	FILING DATE	TOTAL CLAIMS	EXAMINER AND GROUP ART UNIT	DATE MAILED
09/175,685	10/20/98	032	RAO, A	2/13 11/22/99
First Named Applicant	ADAIR, 35 USC 154(b) term ext. = 0 Days.			

TITLE OF INVENTION REDUCED AREA IMAGING DEVICES

ATTY'S DOCKET NO.	CLASS-SUBCLASS	BATCH NO.	APPLN. TYPE	SMALL ENTITY	FEE DUE	DATE DUE
2	F97.13-CIP2	348-076.000	Z99 UTILITY	YES	\$605.00	02/22/00

**THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED.**

**THE ISSUE FEE MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED.**

**HOW TO RESPOND TO THIS NOTICE:**

I. Review the SMALL ENTITY status shown above.  
If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

- A. If the status is changed, pay twice the amount of the FEE DUE shown above and notify the Patent and Trademark Office of the change in status, or
- B. If the status is the same, pay the FEE DUE shown above.

If the SMALL ENTITY is shown as NO:

- A. Pay FEE DUE shown above, or
- B. File verified statement of Small Entity Status before, or with, payment of 1/2 the FEE DUE shown above.

II. Part B-Issue Fee Transmittal should be completed and returned to the Patent and Trademark Office (PTO) with your ISSUE FEE. Even if the ISSUE FEE has already been paid by charge to deposit account, Part B Issue Fee Transmittal should be completed and returned. If you are charging the ISSUE FEE to your deposit account, section "4b" of Part B-Issue Fee Transmittal should be completed and an extra copy of the form should be submitted.

III. All communications regarding this application must give application number and batch number.  
Please direct all communications prior to issuance to Box ISSUE FEE unless advised to the contrary.

**IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.**

PATENT AND TRADEMARK OFFICE COPY

12-20-99  
EXPRESS MAIL NO. 245411390US

PTO/SB/21 (6-98)

Please type a plus sign (+) inside this box → ☐

Approved for use through 09/30/2000. OMB 0651-0031  
Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

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DEC 16 1999

<b>TRANSMITTAL FORM</b> (to be used for all correspondence after initial filing)	Application Number	09/175,685	
	Filing Date	October 20, 1998	
	First Named Inventor	Edwin L. Adair, et al.	
	Group Art Unit	2713	
	Examiner Name	A. Rao	
Total Number of Pages in This Submission	2	Attorney Docket Number	F97.13 CIP2

ENCLOSURES (check all that apply)		
<input type="checkbox"/> Fee Transmittal Form <input type="checkbox"/> Fee Attached <input checked="" type="checkbox"/> Amendment <del>Response</del> 312 <input type="checkbox"/> After Final <input type="checkbox"/> Affidavits/declaration(s) <input type="checkbox"/> Extension of Time Request <input type="checkbox"/> Express Abandonment Request <input type="checkbox"/> Information Disclosure Statement <input type="checkbox"/> Certified Copy of Priority Document(s) <input type="checkbox"/> Response to Missing Parts/Incomplete Application <input type="checkbox"/> Response to Missing Parts under 37 CFR 1.52 or 1.53	<input type="checkbox"/> Assignment Papers (for an Application) <input type="checkbox"/> Drawing(s) <input type="checkbox"/> Licensing-related Papers <input type="checkbox"/> Petition Routing Slip (PTO/SB/69) and Accompanying Petition <input type="checkbox"/> Petition to Convert to a Provisional Application <input type="checkbox"/> Power of Attorney, Revocation Change of Correspondence Address <input type="checkbox"/> Terminal Disclaimer <input type="checkbox"/> Small Entity Statement <input type="checkbox"/> Request for Refund	<input type="checkbox"/> After Allowance Communication to Group <input type="checkbox"/> Appeal Communication to Board of Appeals and Interferences <input type="checkbox"/> Appeal Communication to Group (Appeal Notice, Brief, Reply Brief) <input type="checkbox"/> Proprietary Information <input type="checkbox"/> Status Letter <input type="checkbox"/> Additional Enclosure(s) (please identify below):
Remarks		

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT	
Firm or Individual name	Brent P. Johnson Fields & Johnson, P.C.
Signature	
Date	12/16/99

CERTIFICATE OF MAILING		EXPRESS/
I hereby certify that this correspondence is being deposited with the United States Postal Service as first-class mail in an envelope addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231 on this date: 12/16/99		
Typed or printed name	Katherine L. Goncalves	
Signature		Date 12/16/99

Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

DEC 16 1999

In Re the Continuation-in-Part  
Application of

Edwin L. Adair, Jeffrey L. Adair,  
Randall S. Adair

Serial No.: 09/175,685

Filed: October 20, 1998

For: "Reduced Area Imaging Devices")

) AMENDMENT UNDER  
) 37 C.F.R. §312  
)

) Examiner: A. Rao  
)

) Art Unit: 2713  
)

)

)

)

)

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03

BOX ISSUE FEE - AMENDMENTS  
c/ o Technology Center 2700  
U.S. Patent and Trademark Office  
Washington, D.C. 20231

Sir:

Please amend the above-identified application as follows:

**IN THE CLAIMS:**

Amend Claim 28 as follows:

28. (Twice Amended) An endoscope, as claimed in claim 24,  
further including:

a lens positioned at said distal end of said tubular portion [of  
sensor].

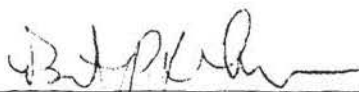
**REMARKS**

Claim 28 has been amended from the previously filed Amendment  
dated September 1, 1999 to correct a typographical error found therein.

Since this Amendment does not affect the scope of the claims or require an additional search by the Patent Examiner, it is earnestly requested that this Amendment be entered.

Respectfully submitted,

FIELDS & JOHNSON, P.C.



Gary D. Fields

Brent P. Johnson

8480 East Orchard Road, Suite 5600

Englewood, CO 80111-5028

(303) 689-9100

Date: 12/16/99

12-20-09 B  
EXPRESS MAIL NO. EL245411390US

Please type a plus sign (+) inside this box → ☒

PTO/SB/21 (6-98)  
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DEC 15 1999

# TRANSMITTAL FORM

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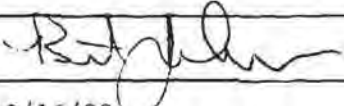
Application Number	09/175,685
Filing Date	October 20, 1998
First Named Inventor	Edwin L. Adair, et al.
Group Art Unit	2713
Examiner Name	A. Rao
Attorney Docket Number	F97.13 CIP2

Total Number of Pages in This Submission 2

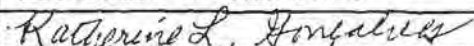
## ENCLOSURES (check all that apply)

<input type="checkbox"/> Fee Transmittal Form	<input type="checkbox"/> Assignment Papers (for an Application)	<input type="checkbox"/> After Allowance Communication to Group
<input type="checkbox"/> Fee Attached	<input type="checkbox"/> Drawing(s)	<input type="checkbox"/> Appeal Communication to Board of Appeals and Interferences
<input type="checkbox"/> Amendment / Response	<input type="checkbox"/> Licensing-related Papers	<input type="checkbox"/> Appeal Communication to Group (Appeal Notice, Brief, Reply Brief)
<input type="checkbox"/> After Final	<input type="checkbox"/> Petition Routing Slip (PTO/SB/69) and Accompanying Petition	<input type="checkbox"/> Proprietary Information
<input type="checkbox"/> Affidavits/declaration(s)	<input type="checkbox"/> Petition to Convert to a Provisional Application	<input type="checkbox"/> Status Letter
<input type="checkbox"/> Extension of Time Request	<input type="checkbox"/> Power of Attorney, Revocation Change of Correspondence Address	<input checked="" type="checkbox"/> Additional Enclosure(s) (please identify below):
<input type="checkbox"/> Express Abandonment Request	<input type="checkbox"/> Terminal Disclaimer	Comments on statement of Reasons for Allowance
<input type="checkbox"/> Information Disclosure Statement	<input type="checkbox"/> Small Entity Statement	
<input type="checkbox"/> Certified Copy of Priority Document(s)	<input type="checkbox"/> Request for Refund	
<input type="checkbox"/> Response to Missing Parts/ Incomplete Application		
<input type="checkbox"/> Response to Missing Parts under 37 CFR 1.52 or 1.53	Remarks	

## SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm or Individual name	Brent P. Johnson Fields & Johnson, P.C.
Signature	
Date	12/16/99

## CERTIFICATE OF MAILING

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Typed or printed name	Katherine L. Goncalves
Signature	
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## IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re the Continuation-in-Part ) COMMENTS ON STATEMENT  
 Application of ) OF REASONS FOR  
 ) ALLOWANCE  
 )  
 Edwin L. Adair, Jeffrey L. Adair, ) Examiner: A. Rao  
 Randall S. Adair )  
 ) Art Unit: 2713  
 Serial No.: 09/175,685 )  
 )  
 Filed: October 20, 1998 )  
 )  
 For: "Reduced Area Imaging )  
 Devices" )

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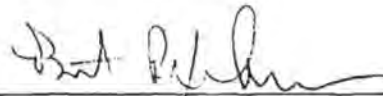
Sir:

In the Notice of Allowability dated November 22, 1999, the Examiner, on page 2 thereof, provided an explanation of Reasons for Allowance. The Examiner's statements with regard to the allowability of Claims 6 and 24 are not accurate. For Claim 6, the Examiner indicated that it recited the arrangement of a reduced area imaging device with the CMOS pixel array with resident timing and control circuitry, the second longitudinally aligned video processing board, and a non-removable lens integral with the imaging device. Claim 6 has no limitation directed to a second longitudinally aligned video processing board. As for Claim 24, the Examiner also stated that this claim recited the arrangement of the use of an endoscope, a CMOS pixel array with resident timing and control circuitry, and a second longitudinally aligned video processing board. Claim 24 has no limitation directed to a second longitudinally aligned video processing

board. It was clearly understood through the prosecution of Claims 6 and 24 that they were allowable for additional reasons not articulated in the Notice of Allowability.

Respectfully submitted,

FIELDS & JOHNSON, P.C.



Gary D. Fields/  
Brent P. Johnson  
Attorneys for Applicant  
8480 East Orchard Road  
Englewood, CO 80111

Date: 12/16/99





12-20-99 1-#

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re the Application of )  
 )  
Edwin L. Adair, Jeffrey L. Adair and )  
Randall S. Adair )  
 )  
Serial No.: 09/175,685 )  
 )  
Filed: October 20, 1998 )  
 )  
For: "Reduced Area Imaging Devices" )

BOX ISSUE FEE - Issue Fee  
c/o Technology Center 2700  
U.S. Patent and Trademark Office  
Washington, D.C. 20231

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Patent Division  
11

Sir:

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Date of Deposit: December 16, 1999

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- Check for \$605.00
- Return postcard

are being deposited with the United States Postal Service "Express Mail  
Post Office to Addressee" service under 37 CFR 1.10 on the date indicated  
above and are addressed to BOX ISSUE FEE, c/o Technology Center 2700,  
U.S. Patent and Trademark Office, Washington, D.C. 20231.

Date: 12/16/99 Virginia A. Sawatzke  
Virginia A. Sawatzke  
8480 E. Orchard Road, Suite 5600  
Englewood, CO 80111  
(303) 689-9100

## PART B—ISSUE FEE TRANSMITTAL

Complete and mail this form, together with app

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Washington, D.C. 20231

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CURRENT CORRESPONDENCE ADDRESS (Note: Legibly mark-up with any corrections or use Block 1)

BRENT P JOHNSON  
FIELDS & JOHNSON  
SUITE 5600  
8480 EAST ORCHARD ROAD  
ENGLEWOOD CO 80111

LM61/1122



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Express Mail No. EL245411390US

Virginia A. Sawatzke (Depositor's name)

Virginia A. Sawatzke (Signature)

December 16, 1999 (Date)

APPLICATION NO.	FILING DATE	TOTAL CLAIMS	EXAMINER AND GROUP ART UNIT	DATE MAILED
09/175,685	10/20/98	032	2713 RAD, A	11/22/99
First Named Applicant: ADAIR, 35 USC 154(b) term ext. = 0 Days.				

TITLE OF INVENTION: REDUCED AREA IMAGING DEVICES

ATTY'S DOCKET NO.	CLASS-SUBCLASS	BATCH NO.	APPLN. TYPE	SMALL ENTITY	FEE DUE	DATE DUE
2	F97.13-CIP2	348-076.000	Z99	UTILITY	YES	\$605.00 02/22/00

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363). Use of PTO form(s) and Customer Number are recommended, but not required.

☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47) attached.

2. For printing on the patent front page, list (1) the names of up to 3 registered patent attorneys or agents OR, alternatively, (2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

Fields and Johnson, P.C.

2

3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

**PLEASE NOTE:** Unless an assignee is identified below, no assignee data will appear on the patent. Inclusion of assignee data is only appropriate when an assignment has been previously submitted to the PTO or is being submitted under separate cover. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY &amp; STATE OR COUNTRY)

Please check the appropriate assignee category indicated below (will not be printed on the patent)

☒ Individual ☐ corporation or other private group entity ☐ government

4a. The following fees are enclosed (make check payable to Commissioner of Patents and Trademarks):

☒ Issue Fee☐ Advance Order - # of Copies

4b. The following fees or deficiency in these fees should be charged to:

DEPOSIT ACCOUNT NUMBER 06-0778

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☒ Issue Fee☐ Advance Order - # of Copies

The COMMISSIONER OF PATENTS AND TRADEMARKS IS requested to apply the Issue Fee to the application identified above.

(Authorized Signature)

(Date)

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Samsung Exhibit 1003

Page 180 of 208

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PATENT APPLICATION SERIAL NO. \_\_\_\_\_

U.S. DEPARTMENT OF COMMERCE  
PATENT AND TRADEMARK OFFICE  
FEE RECORD SHEET

10/23/1998 SCHAPMAN 00000020 09175685

01 FC:201 395.00 DP

PTO-1556  
(5/87)

\*U.S. GPO: 1998-433-214/80404

# **PATENT APPLICATION FEE DETERMINATION RECORD**

Effective October 1, 1997

Application or Docket Number

## **CLAIMS AS FILED - PART I**

(Column 1)

(Column 2)

SMALL ENTITY  
TYPE ☐

OR

OTHER THAN  
SMALL ENTITY

FOR	NUMBER FILED	NUMBER EXTRA
BASIC FEE		
TOTAL CLAIMS	7 minus 20 = *	
INDEPENDENT CLAIMS	2 minus 3 = *	
MULTIPLE DEPENDENT CLAIM PRESENT		

RATE	FEE
	395.00
x\$11=	
x41=	
+135=	
TOTAL	395

RATE	FEE
	790.00
x\$22=	
x82=	
+270=	
TOTAL	

\* If the difference in column 1 is less than zero, enter "0" in column 2

## **CLAIMS AS AMENDED - PART II**

(Column 1)

(Column 2)

(Column 3)

SMALL ENTITY

OR

OTHER THAN  
SMALL ENTITY

AMENDMENT A	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
Total	*	Minus **	=
Independent	*	Minus ***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM			

RATE	ADDI- TIONAL FEE
x\$11=	
x41=	
+135=	
TOTAL ADDIT. FEE	

RATE	ADDI- TIONAL FEE
x\$22=	
x82=	
+270=	
TOTAL ADDIT. FEE	

AMENDMENT B	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
Total	*	Minus **	=
Independent	*	Minus ***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM			

RATE	ADDI- TIONAL FEE
x\$11=	
x41=	
+135=	
TOTAL ADDIT. FEE	

RATE	ADDI- TIONAL FEE
x\$22=	
x82=	
+270=	
TOTAL ADDIT. FEE	

	(Column 1)		(Column 2)	(Column 3)
	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
Total	* 34	Minus	** 20	=
Independent	*	Minus	*** 3	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				

RATE	ADDI- TIONAL FEE
x\$11=	
x41=	
+135=	
TOTAL ADDIT. FEE	

RATE	ADDI- TIONAL FEE
x\$22=	
x82=	
+270=	
TOTAL ADDIT. FEE	

\* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.  
 \*\* If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20."  
 \*\*\* If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3."  
 The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 2.



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## PATENT APPLICATION FEE DETERMINATION RECORD

Application or Docket Number

F97.13 CIP2

## CLAIMS AS FILED - PART I

(Column 1)

(Column 2)

SMALL ENTITY

OR

OTHER THAN  
SMALL ENTITY

FOR	NUMBER FILED	NUMBER EXTRA
BASIC FEE (37 CFR 1.16(a))		
TOTAL CLAIMS (37 CFR 1.16(c))	7 minus 20 = *	0
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2 minus 3 = *	0
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(d))		

RATE	FEE
	\$ 395
x \$ 11 =	0
x 41 =	0
+ =	
TOTAL	395

RATE	FEE
	\$
x \$ 11 =	
x 41 =	
+ =	
TOTAL	

\* If the difference in column 1 is less than zero, enter "0" in column 2

## CLAIMS AS AMENDED - PART II

(Column 1)

(Column 2)

(Column 3)

SMALL ENTITY

OR

OTHER THAN  
SMALL ENTITY

AMENDMENT A	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
Total (37 CFR 1.16(c))	* 29 Minus ** 20 =	9	
Independent (37 CFR 1.16(b))	* 5 Minus *** 3 =	2	
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(d))			

RATE	ADDI- TIONAL FEE
x \$ 9 =	81.00
x 39 =	78.00
+ =	
TOTAL ADDIT. FEE	159.00

RATE	ADDI- TIONAL FEE
x \$ =	
x =	
+ =	
TOTAL ADDIT. FEE	

AMENDMENT B	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
Total (37 CFR 1.16(c))	* 32 Minus ** 29 =	3	
Independent (37 CFR 1.16(b))	* 6 Minus *** 5 =	1	
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(d))			

RATE	ADDI- TIONAL FEE
x \$ 9 =	27.00
x 39 =	39.00
+ =	
TOTAL ADDIT. FEE	66.00

RATE	ADDI- TIONAL FEE
x \$ =	
x =	
+ =	
TOTAL ADDIT. FEE	

AMENDMENT C	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
Total (37 CFR 1.16(c))	* Minus ** =		
Independent (37 CFR 1.16(b))	* Minus *** =		
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(d))			

RATE	ADDI- TIONAL FEE
x \$ =	
x =	
+ =	
TOTAL ADDIT. FEE	

RATE	ADDI- TIONAL FEE
x \$ =	
x =	
+ =	
TOTAL ADDIT. FEE	

\* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

\*\* If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

\*\*\* If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.

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## PATENT APPLICATION FEE DETERMINATION RECORD

Application or Docket Number

F97.13 CIP2

## CLAIMS AS FILED - PART I

(Column 1)

(Column 2)

SMALL ENTITY

OR

OTHER THAN  
SMALL ENTITY

FOR	NUMBER FILED	NUMBER EXTRA
BASIC FEE (37 CFR 1.16(a))		
TOTAL CLAIMS (37 CFR 1.16(c))	7 minus 20 = *	0
INDEPENDENT CLAIMS (37 CFR 1.16(b))	2 minus 3 = *	0
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(d))		

RATE	FEE
	\$ 395
x \$11 =	0
x 41 =	0
+ =	
TOTAL	395

RATE	FEE
	\$
x \$11 =	
x 41 =	
+ =	
TOTAL	

\* If the difference in column 1 is less than zero, enter "0" in column 2

## CLAIMS AS AMENDED - PART II

(Column 1)

(Column 2)

(Column 3)

SMALL ENTITY

OR

OTHER THAN  
SMALL ENTITY

AMENDMENT A	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
Total (37 CFR 1.16(c))	*	Minus **	=
Independent (37 CFR 1.16(b))	*	Minus ***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(d))			

RATE	ADDI- TIONAL FEE
x \$ =	
x =	
+ =	
TOTAL ADDIT. FEE	

RATE	ADDI- TIONAL FEE
x \$ =	
x =	
+ =	
TOTAL ADDIT. FEE	

AMENDMENT B	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
Total (37 CFR 1.16(c))	*	Minus **	=
Independent (37 CFR 1.16(b))	*	Minus ***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(d))			

RATE	ADDI- TIONAL FEE
x \$ =	
x =	
+ =	
TOTAL ADDIT. FEE	

RATE	ADDI- TIONAL FEE
x \$ =	
x =	
+ =	
TOTAL ADDIT. FEE	

AMENDMENT C	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
Total (37 CFR 1.16(c))	*	Minus **	=
Independent (37 CFR 1.16(b))	*	Minus ***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(d))			

RATE	ADDI- TIONAL FEE
x \$ =	
x =	
+ =	
TOTAL ADDIT. FEE	

RATE	ADDI- TIONAL FEE
x \$ =	
x =	
+ =	
TOTAL ADDIT. FEE	

\* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

\*\* If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

\*\*\* If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case.  
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Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for  
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# PATENT APPLICATION FEE DETERMINATION RECORD

Application or Docket Number  
F97.13 CIP2

## CLAIMS AS FILED - PART I

(Column 1)

(Column 2)

SMALL ENTITY

OR

OTHER THAN  
SMALL ENTITY

FOR	NUMBER FILED	NUMBER EXTRA
BASIC FEE (37 CFR 1.16(a))		
TOTAL CLAIMS (37 CFR 1.16(c))	7 minus 20 = *	0
INDEPENDENT CLAIMS (37 CFR 1.16(b))	2 minus 3 = *	0
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(d))		

RATE	FEE
	\$ 395
x \$ =	0
x =	0
+ =	
TOTAL	395

RATE	FEE
	\$
x \$ =	
x =	
+ =	
TOTAL	

\* If the difference in column 1 is less than zero, enter "0" in column 2

## CLAIMS AS AMENDED - PART II

(Column 1)

(Column 2)

(Column 3)

SMALL ENTITY

OR

OTHER THAN  
SMALL ENTITY

AMENDMENT A	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
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	Independent (37 CFR 1.16(b))	* 5	Minus *** 0	= 2
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+ =	
TOTAL ADDIT. FEE	159

RATE	ADDI- TIONAL FEE
x \$ =	
x =	
+ =	
TOTAL ADDIT. FEE	

AMENDMENT B	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
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	Independent (37 CFR 1.16(b))	* 5	Minus *** 2	= 0
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(d))			

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x \$ 9 =	18
x 0 =	0
+ =	
TOTAL ADDIT. FEE	18

RATE	ADDI- TIONAL FEE
x \$ =	
x =	
+ =	
TOTAL ADDIT. FEE	

AMENDMENT C	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
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	Independent (37 CFR 1.16(b))	* Minus *** 5	=	
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(d))			

RATE	ADDI- TIONAL FEE
x \$ =	
x =	
+ =	
TOTAL ADDIT. FEE	

RATE	ADDI- TIONAL FEE
x \$ =	
x =	
+ =	
TOTAL ADDIT. FEE	

- \* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
- \*\* If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
- \*\*\* If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.



POSITION	INITIALS	ID NO.	DATE
FEE DETERMINATION	SL		
O.I.P.E. CLASSIFIER		8	10-26-98
FORMALITY REVIEW	KS	71702	10-29

# INDEX OF CLAIMS

✓ ..... Rejected  
 = ..... Allowed  
 - (Through numeral) ..... Canceled  
 + ..... Restricted  
 N ..... Non-elected  
 I ..... Interference  
 A ..... Appeal  
 O ..... Objected

Claim	Date	Claim	Date	Claim	Date
Final Original		Final Original		Final Original	
1 1	8/2/99	51		101	
2 2	8/2/99	52		102	
3 3	8/2/99	53		103	
4 4	8/2/99	54		104	
5 5	8/2/99	55		105	
6 6	8/2/99	56		106	
7 7	8/2/99	57		107	
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48 48	8/2/99	98		148	
49 49	8/2/99	99		149	
50 50	8/2/99	100		150	

If more than 150 claims or 10 actions  
staple additional sheet here

(LEFT INSIDE)

SEARCHED			
Class	Sub.	Date	Exmr.
348	65	8/2/99	AK
↓	71	↓	↓
	74		
	76		
	77		
	78		
	61		
	376		
↓	375		
600	108		
↓	109		
	113		
↓	117	↓	↓
UPDATE	SEARCH	11/18/99	AK

SEARCH NOTES (INCLUDING SEARCH STRATEGY)		
	Date	Exmr.

INTERFERENCE SEARCHED			
Class	Sub.	Date	Exmr.
345 600	60-400 106-120	4/18/91 ↓	↓



US006043839A

**United States Patent** [19]

Adair et al.

[11] **Patent Number:** **6,043,839**[45] **Date of Patent:** **Mar. 28, 2000**[54] **REDUCED AREA IMAGING DEVICES**

- [76] Inventors: **Edwin L. Adair**, 317 Paragon Way,  
Castle Pines Village, Colo. 80104;  
**Jeffrey L. Adair**, 1861 E. Redfox Pl.,  
Highlands Ranch, Colo. 80126; **Randall**  
**S. Adair**, 3082 S. Flamingo Way,  
Denver, Colo. 80222

[21] Appl. No.: **09/175,685**[22] Filed: **Oct. 20, 1998****Related U.S. Application Data**

- [63] Continuation-in-part of application No. 08/944,322, Oct. 6, 1997.
- [51] **Int. Cl.**<sup>7</sup> ..... **H04N 7/16**
- [52] **U.S. Cl.** ..... **348/76; 348/65; 348/71;**  
348/376; 600/108
- [58] **Field of Search** ..... **348/65, 71, 74,**  
348/76, 77, 78, 61, 376, 375; 600/108,  
109, 113, 117

[56] **References Cited****U.S. PATENT DOCUMENTS**

Re. 33,854	3/1992	Adair	128/6
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"Active-Pixel Image Sensor Integrated With Readout Circuits", *NASA Tech Briefs*, Oct. 1996.

"NASA's Tiny Camera Has a Wide-Angle Future", *Business Week*, Mar. 6, 1995.

"Imaging Options Expand With CMOS Technology", *Laser Focus World*, Jun. 1997.

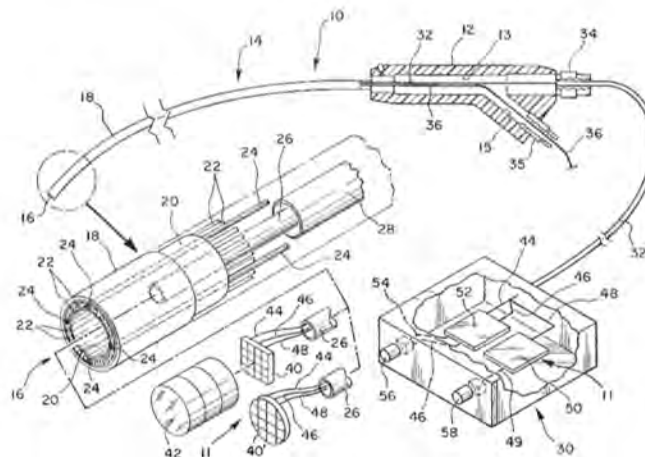
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*Primary Examiner*—Andy Rao

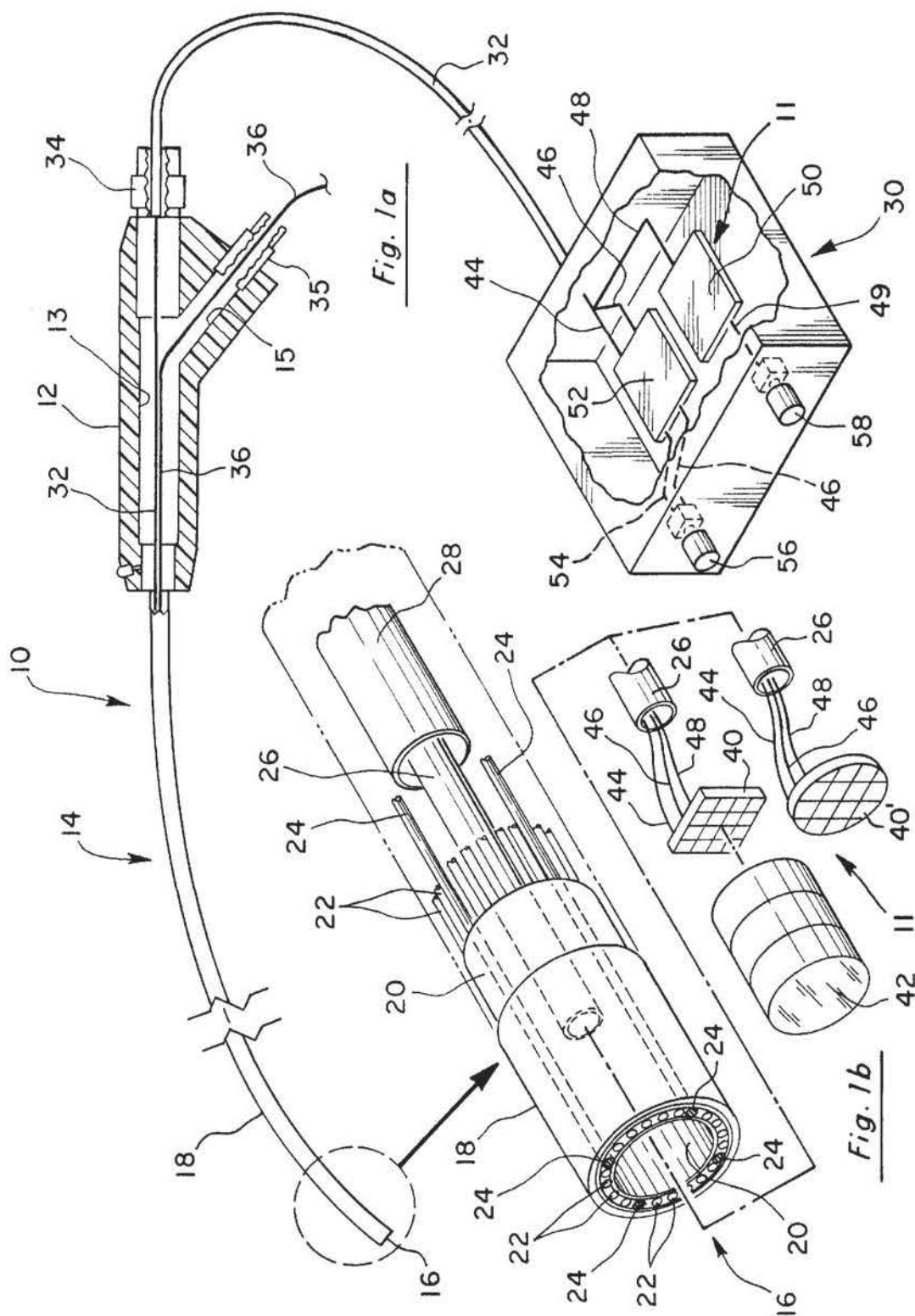
*Attorney, Agent, or Firm*—Fields and Johnson, P.C.

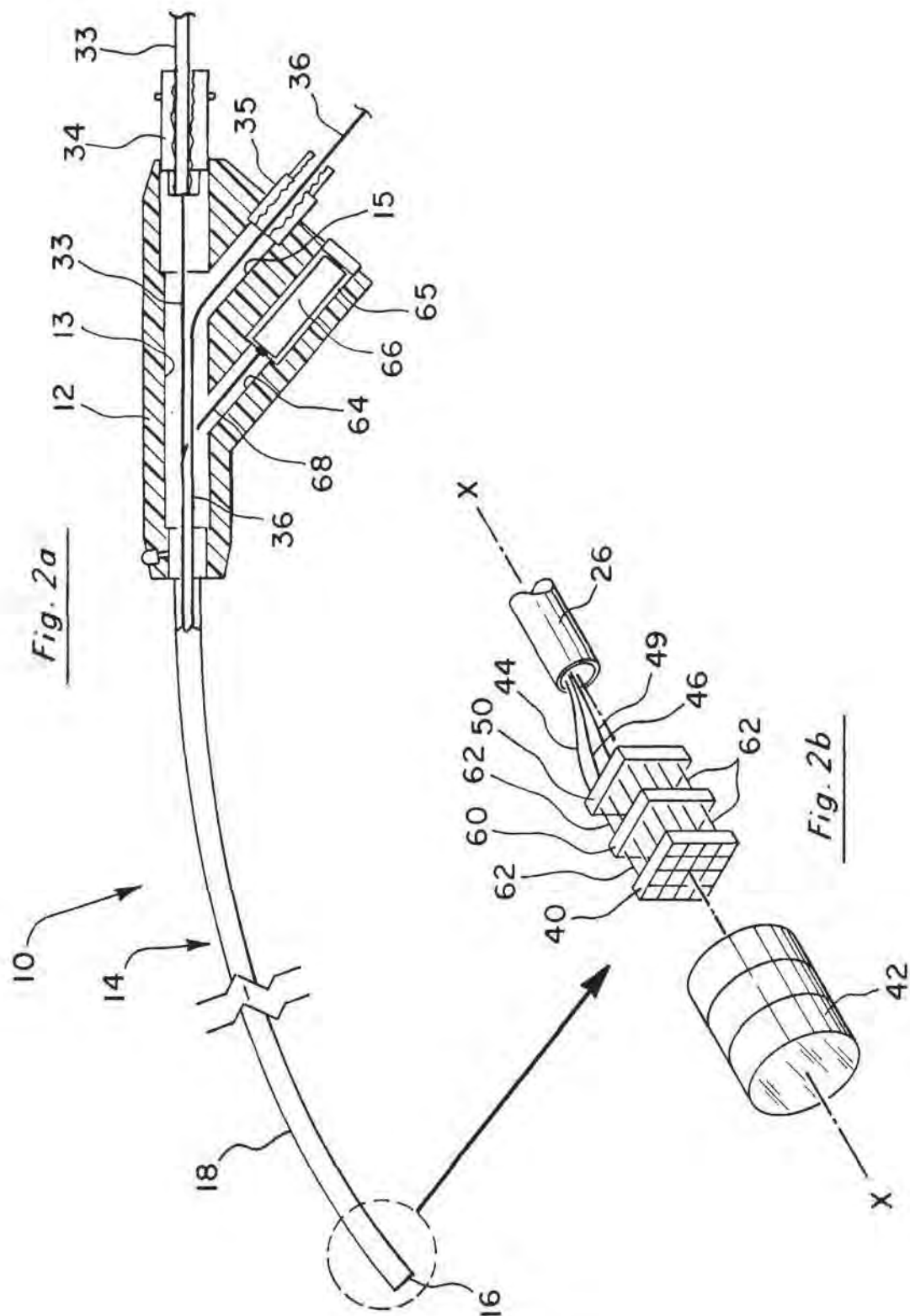
[57] **ABSTRACT**

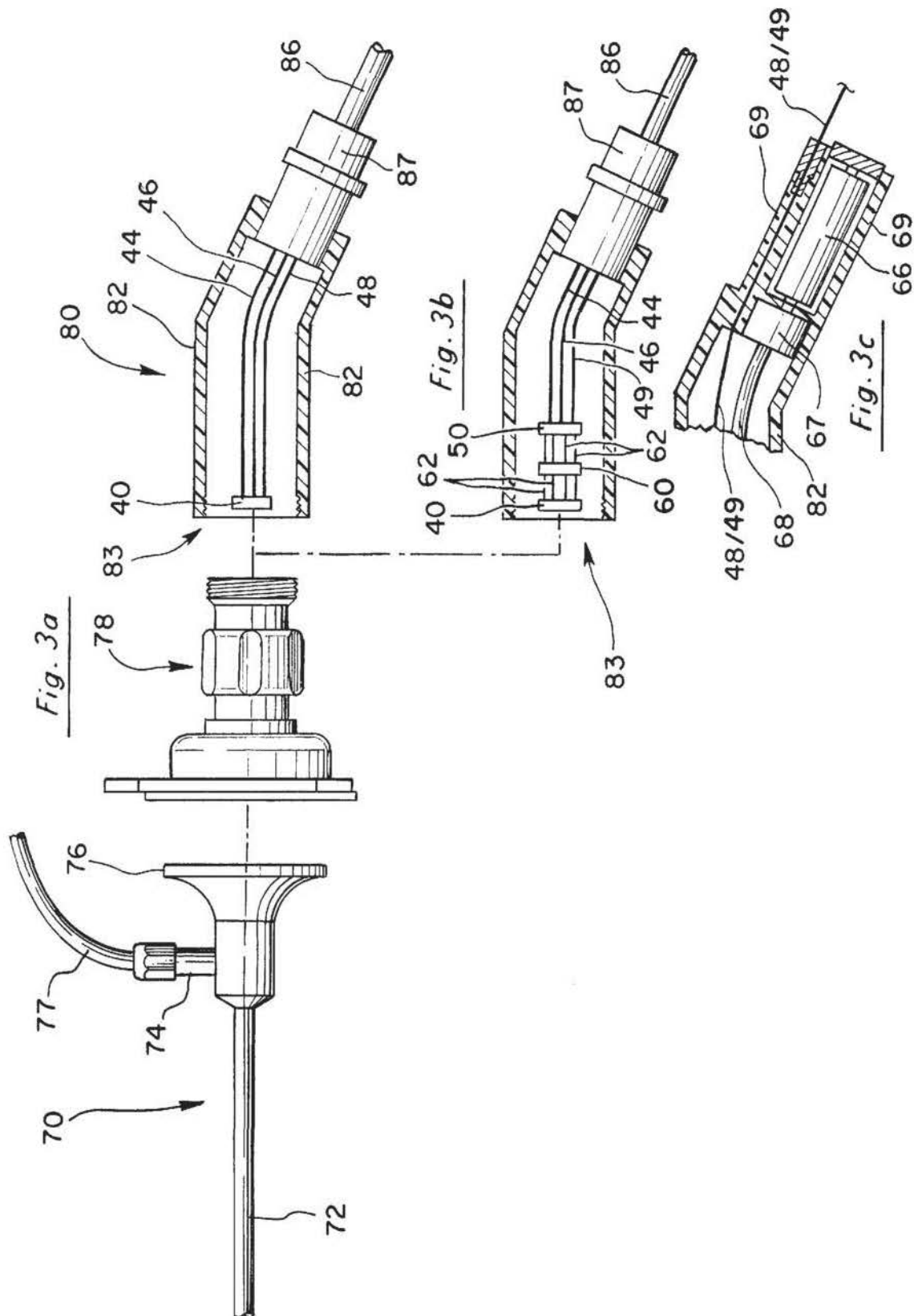
A reduced area imaging device is provided for use in medical or dental instruments such as an endoscope. In one configuration of the imaging device, the image sensor is placed remote from the remaining circuitry. In another configuration, all of the circuitry to include the image sensor is placed in a stacked fashion at the same location. In a first embodiment of the invention, the entire imaging device can be placed at the distal tip of an endoscope. In a second embodiment, the image sensor is remote from the remaining circuitry according to the first configuration, and wherein a control box can be provided which communicates with the image sensor and is placed remotely from the endoscope. In yet another embodiment, the imaging device can be incorporated in the housing of a standard medical camera which is adapted for use with traditional rod lens endoscopes. In any of the embodiments, the image sensor may be placed alone on a first circuit board, or timing and control circuits may be included on the first circuit board containing the image sensor. One or more video processing boards can be stacked in a longitudinal fashion with respect to the first board, or the video processing boards may be placed in the control box.

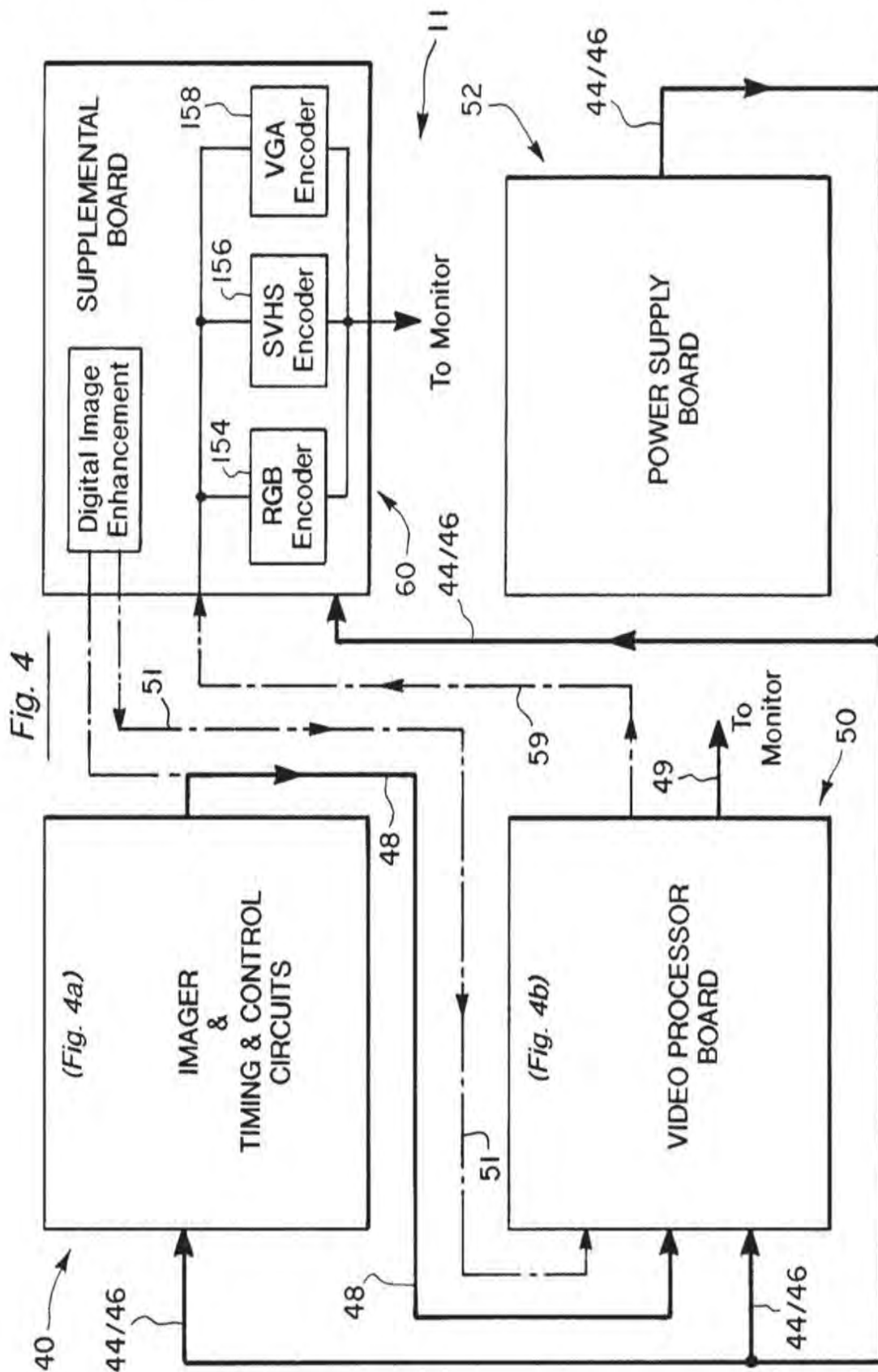
**32 Claims, 11 Drawing Sheets**



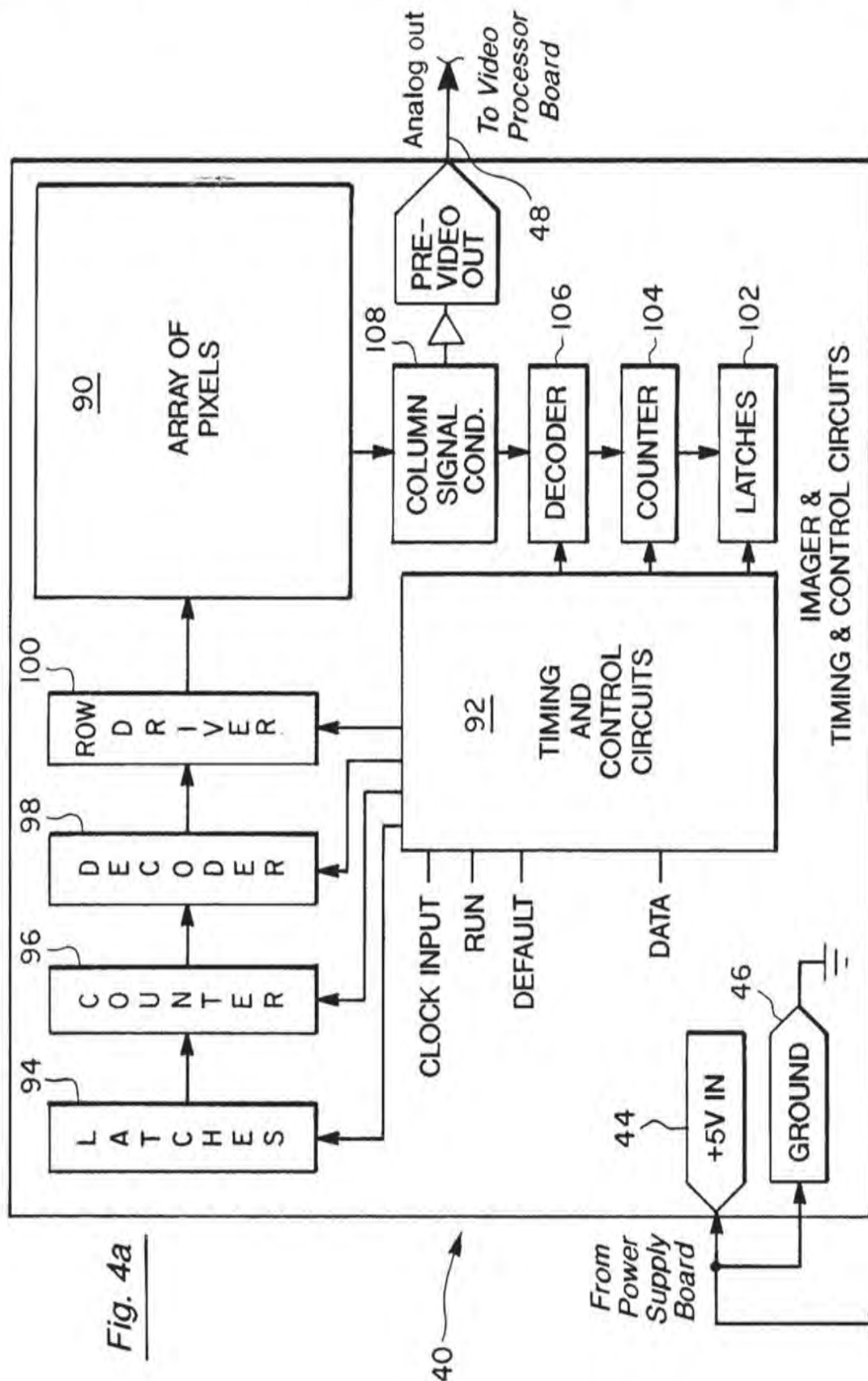


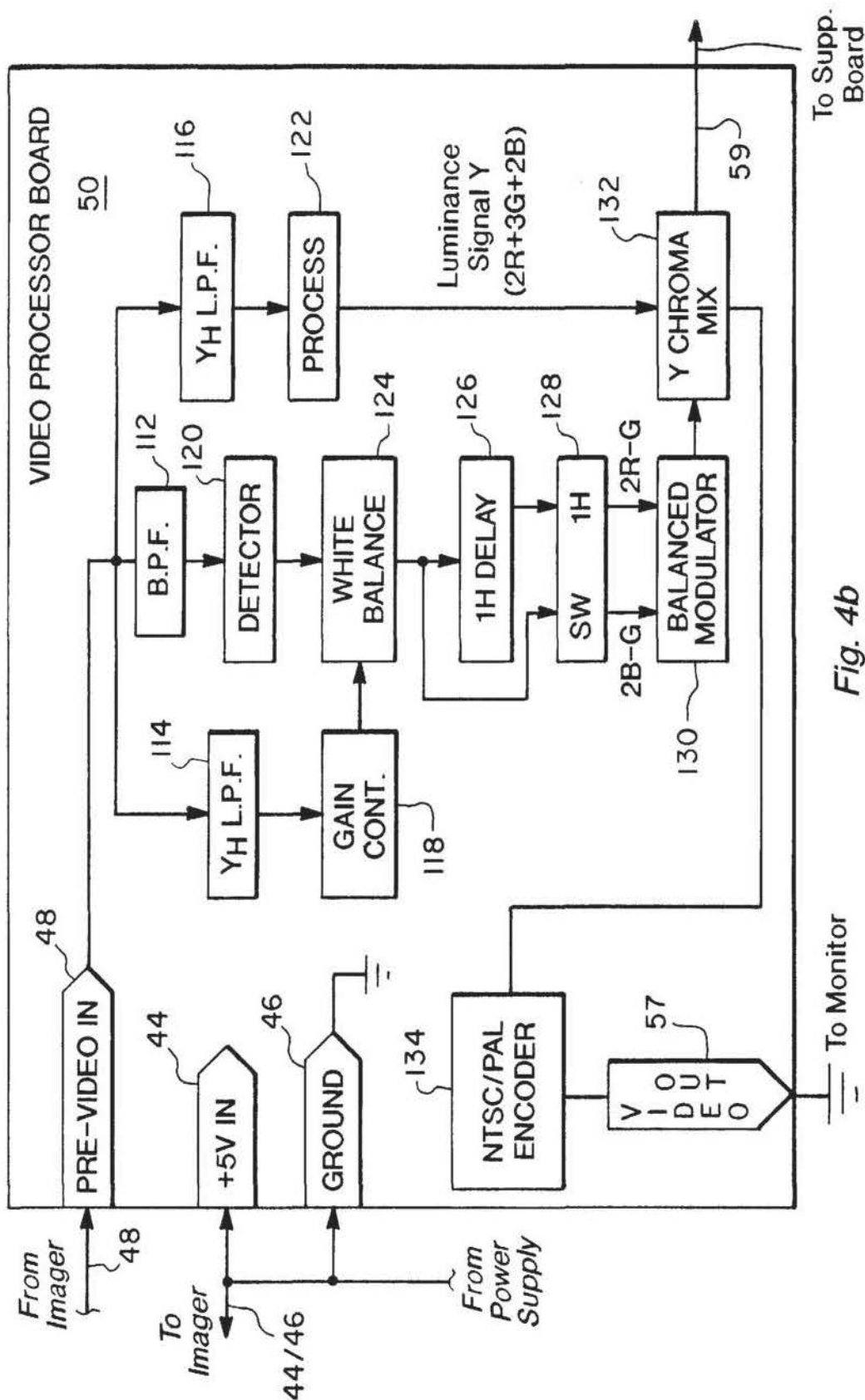












**Fig. 4b**

Fig. 5a

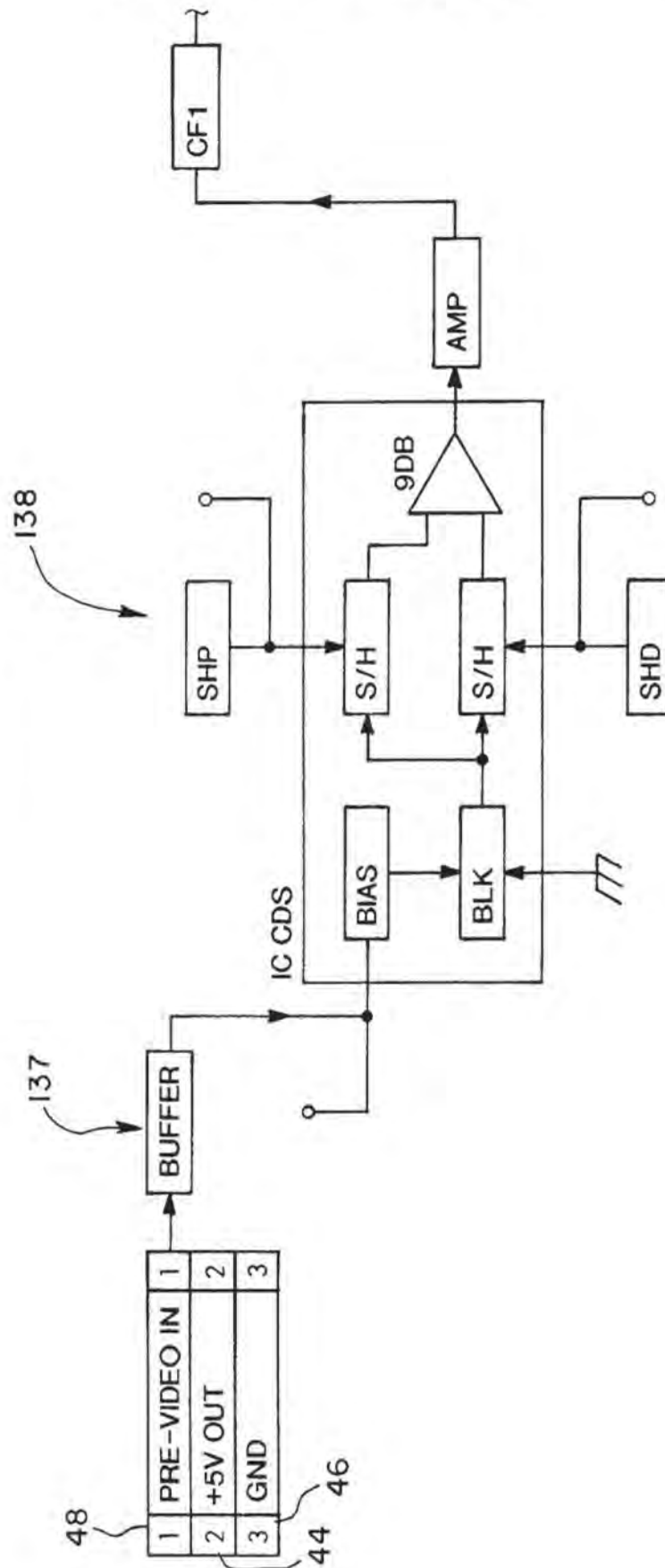


Fig. 5b

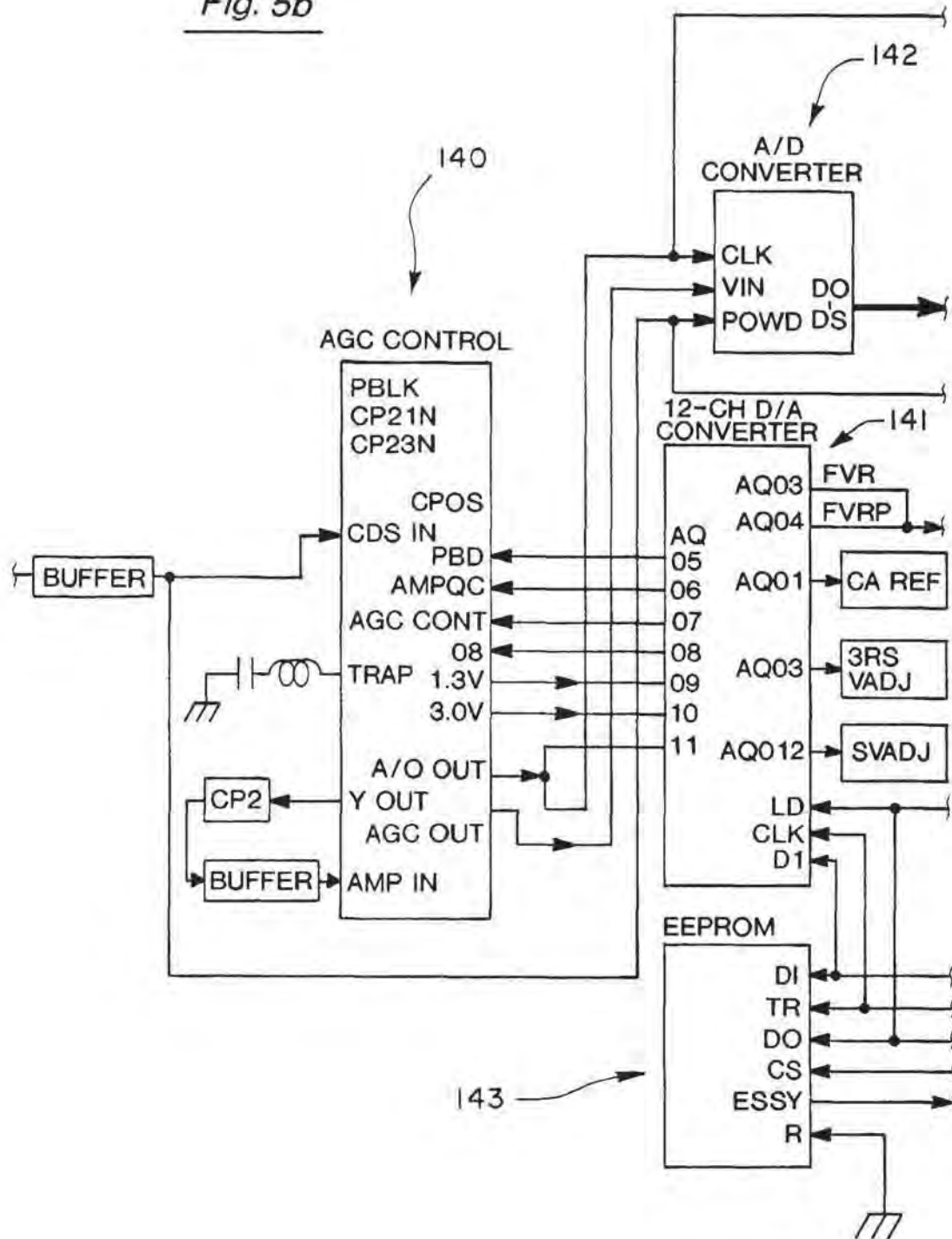
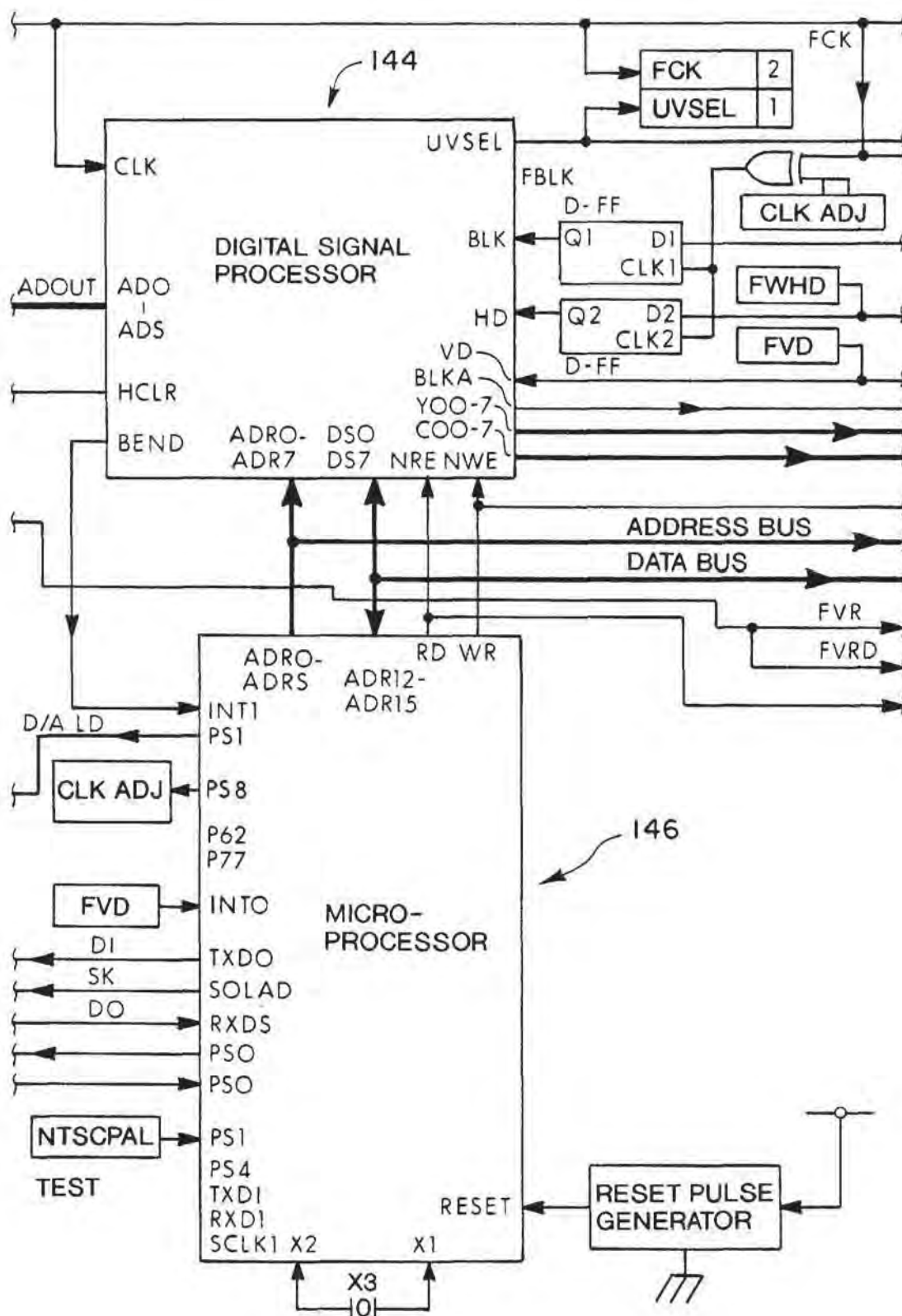
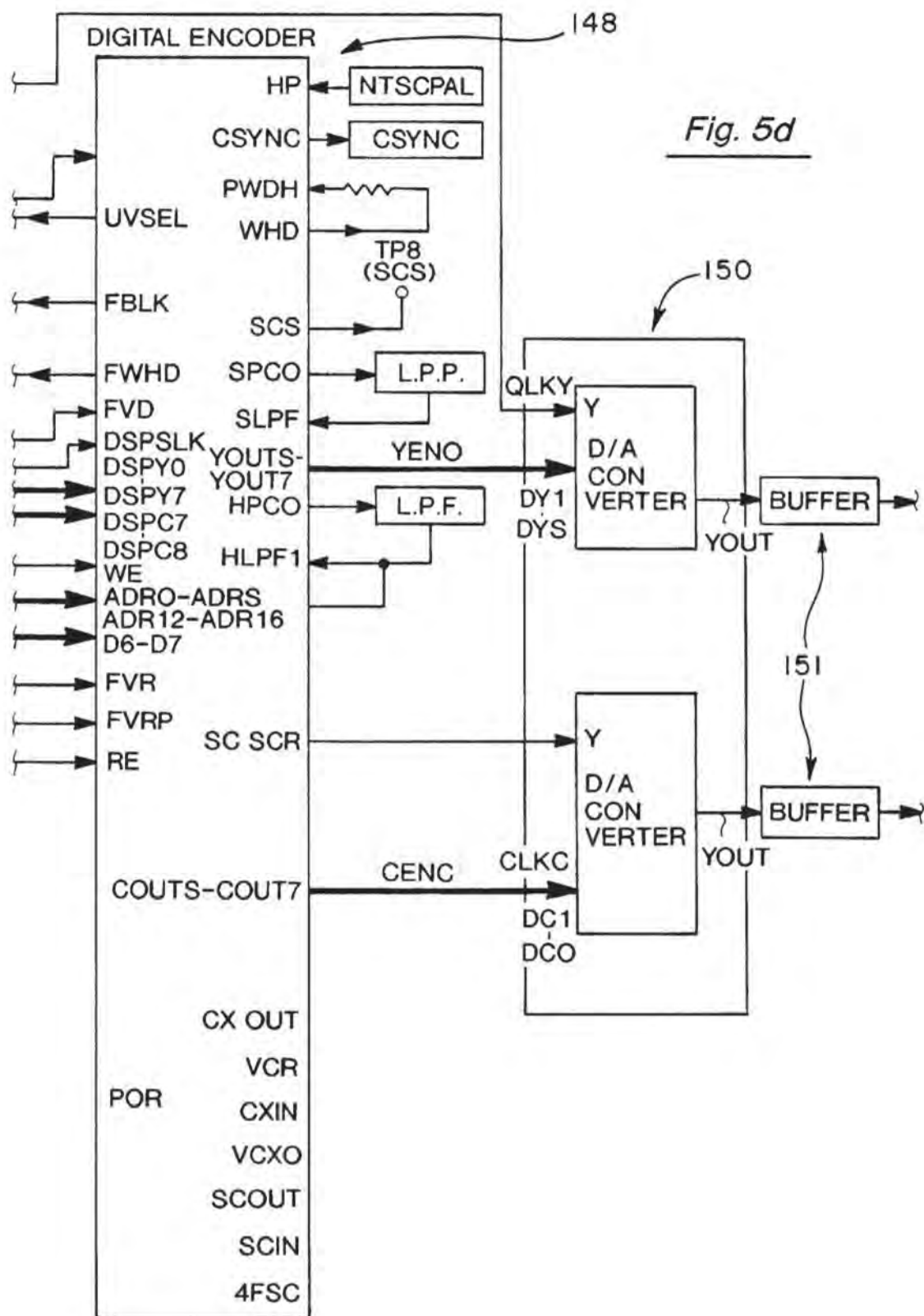


Fig. 5c





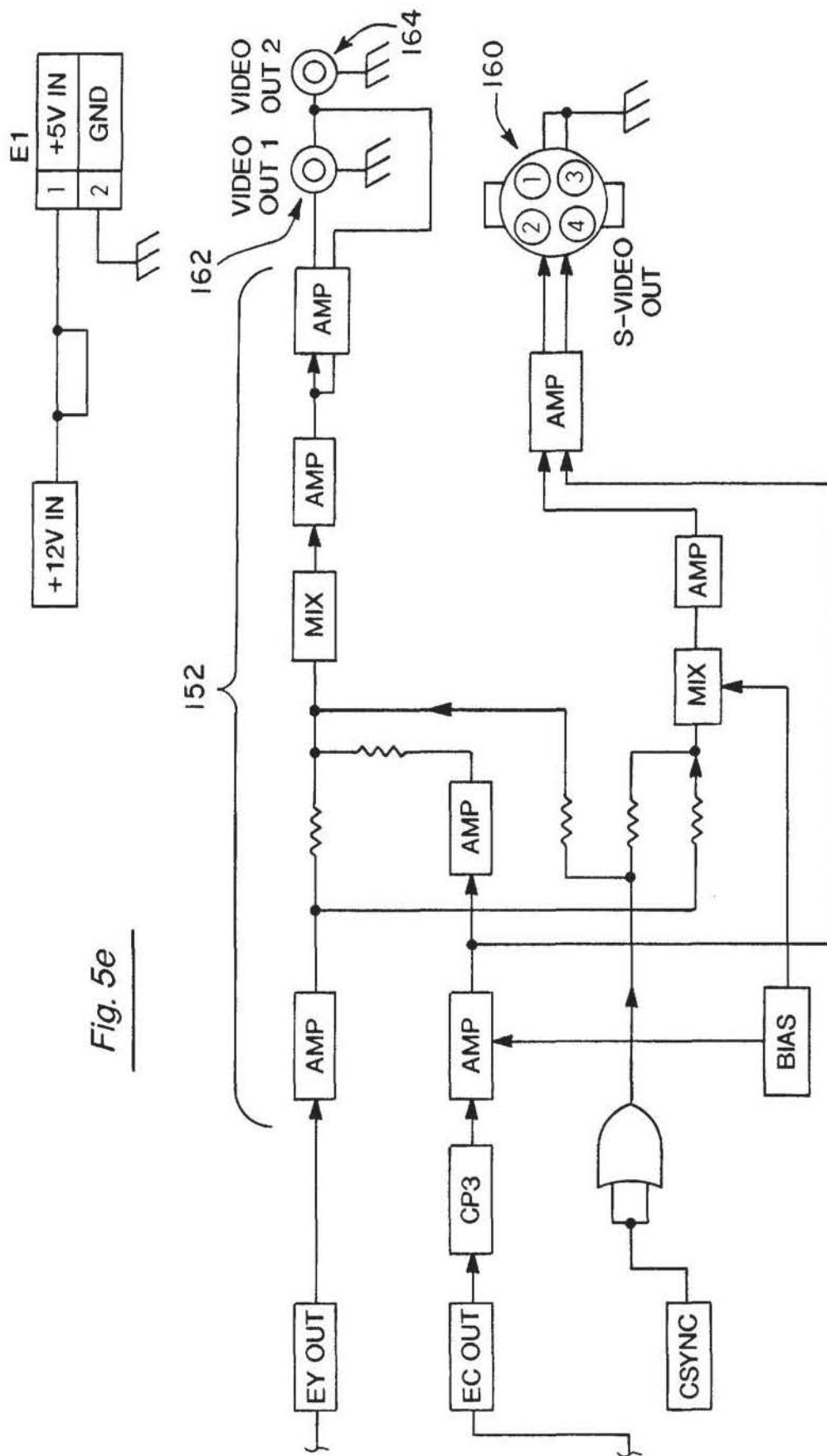


Fig. 5e

## REDUCED AREA IMAGING DEVICES

This application is a continuation-in-part of U.S. Ser. No. 08/944,322, filed Oct. 6, 1997, and entitled "Reduced Area Imaging Devices Incorporated Within Surgical Instruments."

## TECHNICAL FIELD

This invention relates to solid state image sensors and associated electronics, and more particularly, to solid state image sensors which are configured to be of a minimum size.

## BACKGROUND ART

In recent years, endoscopic surgery has become the accepted standard for conducting many types of surgical procedures, both in the medical and dental arenas. The availability of imaging devices enabling a surgeon or dentist to view a particular surgical area through a small diameter endoscope which is introduced into small cavities or openings in the body results in much less patient trauma as well as many other advantages.

In many hospitals, the rod lens endoscope is still used in endoscopic surgery. The rod lens endoscope includes a very precise group of lenses in an elongate and rigid tube which are able to accurately transmit an image to a remote camera in line with the lens group. The rod lens endoscope, because of its cost of manufacture, failure rate, and requirement to be housed within a rigid and straight housing, is being increasingly replaced by solid state imaging technology which enables the image sensor to be placed at the distal tip of the investigating device. The three most common solid state image sensors include charged coupled devices (CCD), charge injection devices (CID) and photo diode arrays (PDA). In the mid-1980s, complementary metal oxide semiconductors (CMOS) were developed for industrial use. CMOS imaging devices offer improved functionality and simplified system interfacing. Furthermore, many CMOS imagers can be manufactured at a fraction of the cost of other solid state imaging technologies.

One particular advance in CMOS technology has been in the active pixel-type CMOS imagers which consist of randomly accessible pixels with an amplifier at each pixel site. One advantage of active pixel-type imagers is that the amplifier placement results in lower noise levels than CCDs or other solid state imagers. Another major advantage is that these CMOS imagers can be mass produced on standard semiconductor production lines. One particularly notable advance in the area of CMOS imagers including active pixel-type arrays is the CMOS imager described in U.S. Pat. No. 5,471,515 to Fossum, et al. This CMOS imager can incorporate a number of other different electronic controls that are usually found on multiple circuit boards of much larger size. For example, timing circuits, and special functions such as zoom and anti-jitter controls can be placed on the same circuit board containing the CMOS pixel array without significantly increasing the overall size of the host circuit board. Furthermore, this particular CMOS imager requires 100 times less power than a CCD-type imager. In short, the CMOS imager disclosed in Fossum, et al. has enabled the development of a "camera on a chip."

Passive pixel-type CMOS imagers have also been improved so that they too can be used in an imaging device which qualifies as a "camera on a chip." In short, the major difference between passive and active CMOS pixel arrays is that a passive pixel-type imager does not perform signal

amplification at each pixel site. One example of a manufacturer which has developed a passive pixel array with performance nearly equal to known active pixel devices and being compatible with the read out circuitry disclosed in the U.S. Pat. No. 5,471,515 is VLSI Vision, Ltd., 1190 Saratoga Avenue, Suite 180, San Jose, Calif. 95129. A further description of this passive pixel device may be found in co-pending application, Ser. No. 08/976,976, entitled "Reduced Area Imaging Devices Incorporated Within Surgical Instruments," and is hereby incorporated by reference.

In addition to the active pixel-type CMOS imager which is disclosed in U.S. Pat. No. 5,471,515, there have been developments in the industry for other solid state imagers which have resulted in the ability to have a "camera on a chip." For example, Suni Microsystems, Inc. of Mountain View, Calif., has developed a CCD/CMOS hybrid which combines the high quality image processing of CCDs with standard CMOS circuitry construction. In short, Suni Microsystems, Inc. has modified the standard CMOS and CCD manufacturing processes to create a hybrid process providing CCD components with their own substrate which is separate from the P well and N well substrates used by the CMOS components. Accordingly, the CCD and CMOS components of the hybrid may reside on different regions of the same chip or wafer. Additionally, this hybrid is able to run on a low power source (5 volts) which is normally not possible on standard CCD imagers which require 10 to 30 volt power supplies. A brief explanation of this CCD/CMOS hybrid can be found in the article entitled "Startup Suni Bets on Integrated Process" found in *Electronic News*, Jan. 20, 1997 issue. This reference is hereby incorporated by reference for purposes of explaining this particular type of imaging processor.

Another example of a recent development in solid state imaging is the development of CMOS imaging sensor which is able to achieve analog to digital conversion on each of the pixels within the pixel array. This type of improved CMOS imager includes transistors at every pixel to provide digital instead of analog output that enable the delivery of decoders and sense amplifiers much like standard memory chips. With this new technology, it may, therefore, be possible to manufacture a true digital "camera on a chip." This CMOS imager has been developed by a Stanford University joint project and is headed by Professor Abbas el-Gamal.

A second approach to creating a CMOS-based digital imaging device includes the use of an over-sample converter at each pixel with a one bit comparator placed at the edge of the pixel array instead of performing all of the analog to digital functions on the pixel. This new design technology has been called MOSAD (multiplexed over sample analog to digital) conversion. The result of this new process is low power usage, along with the capability to achieve enhanced dynamic range, possibly up to 20 bits. This process has been developed by Amain Electronics of Simi Valley, Calif. A brief description of both of the processes developed by Stanford University and Amain Electronics can be found in an article entitled "A/D Conversion Revolution for CMOS Sensor?," September 1998 issue of *Advanced Imaging*. This reference is also hereby incorporated by reference for purposes of explaining these particular types of imaging processors.

The above-mentioned developments in solid state imaging technology have shown that "camera on a chip" devices will continue to be enhanced not only in terms of the quality of imaging which may be achieved, but also in the specific construction of the devices which may be manufactured by new breakthrough processes.

Although the "camera on a chip" concept is one which has great merit for application in many industrial areas, a need still exists for a reduced area imaging device which can be used in even the smallest type of endoscopic instruments in order to view areas in the body that are particularly difficult to access, and to further minimize patient trauma by an even smaller diameter invasive instrument.

It is one object of this invention to provide reduced area imaging devices which take advantage of "camera on a chip" technology, but rearrange the circuitry in a stacked relationship so that there is a minimum profile presented when used within a surgical instrument or other investigative device. It is another object of this invention to provide low cost imaging devices which may be "disposable." It is yet another object of this invention to provide reduced area imaging devices which may be used in conjunction with standard endoscopes by placing the imaging device through channels which normally receive other surgical devices, or receive liquids or gases for flushing a surgical area. It is yet another object of this invention to provide a surgical device with imaging capability which may be battery powered and only requires one conductor for transmitting a pre-video signal to video processing circuitry within or outside the sterile field of the surgical area.

In addition to the intended use of the foregoing invention with respect to surgical procedures conducted by medical doctors, it is also contemplated that the invention described herein has great utility with respect to oral surgery and general dental procedures wherein a very small imaging device can be used to provide an image of particularly difficult to access locations. Additionally, while the foregoing invention has application with respect to the medical and dental fields, it will also be appreciated by those skilled in the art that the small size of the imaging device set forth herein can be applied to other functional disciplines wherein the imaging device can be used to view difficult to access locations for industrial equipment and the like. Therefore, the imaging device of this invention could be used to replace many industrial boroscopes.

The "camera on a chip" technology can be furthered improved with respect to reducing its profile area and incorporating such a reduced area imaging device into very small investigative instruments which can be used in the medical, dental, or other industrial fields.

#### DISCLOSURE OF THE INVENTION

In accordance with the present invention, reduced area imaging devices are provided. The term "imaging device" as used herein describes the imaging elements and processing circuitry which is used to produce a video signal which may be accepted by a standard video device such as a television or video monitor accompanying a personal computer. The term "image sensor" as used herein describes the components of a solid state imaging device which captures images and stores them within the structure of each of the pixels in the array of pixels found in the imaging device. As further discussed below, the timing and control circuits can be placed either on the same planar structure as the pixel array, in which case the image sensor can also be defined as an integrated circuit, or the timing and control circuitry can be placed remote from the pixel array. The terms "signal" or "image signal" as used herein, and unless otherwise more specifically defined, refer to an image which at some point during its processing by the imaging device, is found in the form of electrons which have been placed in a specific format or domain. The term "processing circuitry" as used

herein refers to the electronic components within the imaging device which receive the image signal from the image sensor and ultimately place the image signal in a usable format. The terms "timing and control circuits" or "circuitry" as used herein refer to the electronic components which control the release of the image signal from the pixel array.

In a first embodiment, the image sensor, with or without the timing and control circuitry, may be placed at the distal tip of the endoscopic instrument while the remaining processing circuitry may be found in a small remote control box which may communicate with the image sensor by a single cable.

In a second embodiment, the image sensor and the processing circuitry may all be placed in a stacked arrangement of circuit boards and positioned at the distal tip of the endoscopic instrument. In this embodiment, the pixel array of the image sensor may be placed by itself on its own circuit board while the timing and control circuitry and processing circuitry are placed on one or more other circuit boards. Alternatively, the circuitry for timing and control may be placed with the pixel array on one circuit board, while the remaining processing circuitry can be placed on one or more of the other circuit boards.

In yet another embodiment, the imaging device may be adapted for use with a standard rod lens endoscope wherein the imaging device is placed within a standard camera housing which is configured to connect to a standard "C" or "V" mount connector.

A generic endoscope may be used in the first and second embodiments which includes a very small diameter tubular portion which is inserted within the patient. The tubular portion may be made of a flexible material having a central lumen or opening therein for receiving the elements of the imaging device. The tubular portion may be modified to include an additional concentric tube placed within the central lumen and which enables a plurality of light fibers to be placed circumferentially around the periphery of the distal end of the tubular portion. Additionally, control wires may extend along the tubular portion in order to make the endoscope steerable. The material used to make the endoscope can be compatible with any desired sterilization protocol, or the entire endoscope can be made sterile and disposable after use.

For the configuration of the imaging device which calls for the array of pixels and the timing and control circuitry to be placed on the same circuit board, only one conductor is required in order to transmit the image signal to the processing circuitry. In the other configuration of the imaging device wherein the timing and control circuits are incorporated onto other circuit boards, a plurality of connections are required in order to connect the timing and control circuitry to the pixel array and the one conductor is also required to transmit the image signal.

#### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1a illustrates a first embodiment including a fragmentary cross-sectional view of a generic endoscopic instrument, and a fragmentary perspective view of a control box, the endoscope and control box each incorporating elements of a reduced area imaging device;

FIG. 1b is an enlarged fragmentary partially exploded perspective view of the distal end of the endoscopic instrument specifically illustrating the arrangement of the image sensor with respect to the other elements of the tubular portion of the endoscope;

FIG. 2a is a fragmentary cross-sectional view of a second embodiment of this invention illustrating another generic endoscope wherein the imaging device is incorporated in its entirety at the distal tip of the endoscope;

FIG. 2b is an enlarged fragmentary partially exploded perspective view of the distal end of the endoscope of FIG. 2a illustrating the imaging device;

FIG. 3a is an elevational fragmentary cross-sectional view of the image sensor incorporated with a standard camera housing for connection to a rod lens endoscope;

FIG. 3b is a fragmentary cross-sectional view of the imaging device incorporated within the camera housing of FIG. 3a;

FIG. 3c is a fragmentary cross-sectional view similar to that of FIG. 3b illustrating a battery as an alternate source of power;

FIG. 4 is a schematic diagram of the functional electronic components which make up the imaging device;

FIG. 4a is an enlarged schematic diagram of a circuit board which may include the array of pixels and the timing and control circuitry;

FIG. 4b is an enlarged schematic diagram of a video processing board having placed thereon the processing circuitry which processes the pre-video signal generated by the array of pixels and which converts the pre-video signal to a post-video signal which may be accepted by a standard video device; and

FIGS. 5a-5e are schematic diagrams that illustrate an example of specific circuitry which may be used to make the imaging device.

#### BEST MODE FOR CARRYING OUT THE INVENTION

In accordance with one embodiment of the invention as shown in FIG. 1a, an endoscope 10 is provided which incorporates a reduced area imaging device 11, shown in FIG. 1b. As further discussed below, the elements of the imaging device may all be found at one location or the elements may be separated from one another and interconnected by the appropriate cable(s). The array of pixels making up the image sensor captures images and stores them in the form of electrical energy by conversion of light photons to electrons. This conversion takes place by the photo diodes in each pixel which communicate with one or more capacitors which store the electrons. The structure of the endoscope 10 includes a flexible or rigid tubular portion 14 which is inserted into the body of the patient and is placed at the appropriate location for viewing a desired surgical area. The tubular portion 14 attaches at its proximal end to a handle portion 12 which may be grasped by a surgeon who is conducting the endoscopic procedure. The handle 12 may include a central lumen or channel 13 which receives therethrough one or more cables or other structures which extend to the distal end 16 of tubular portion 14. Handle portion 12 may further include a supplementary channel 15 which intersects with central channel 13 and which may provide another point of entry for other cables, fluids or operative instruments to be placed through the endoscope.

FIG. 1b illustrates the distal end of the endoscope 16. The distal end 16 may be characterized by an outer tube 18 which traverses the length of the tubular portion 14 and connects to the handle portion 12. Placed concentrically within the outer tube 18 may be one or more inner tubes 20. In FIG. 1b, the gap between inner tube 20 and outer tube 18 forms a space in which one or more light fibers 22 or control wires 24 may

be placed. As well understood by those skilled in the art, a plurality of circumferentially spaced light fibers as illustrated in FIG. 1b can be used to illuminate the surgical site. Additionally, the control wires 24 may communicate with a control mechanism (not shown) integrated on the handle portion 12 for manipulating the distal end 16 of the endoscope in a desired direction. The flexible tubular portion 14 coupled with a steerable feature enables the endoscope to be placed within winding bodily passages or other locations difficult to reach within the body.

An image sensor 40 may be placed within the central channel defined by inner tube 20. In the configuration shown in FIG. 1b, a cable 26 is used to house the conductors which communicate with the image sensor 40. An intermediate support tube 28 may be placed concentrically outside of cable 26 and concentrically within inner tube 20 to provide the necessary support for the cable 26 as it traverses through the inner channel defined by inner tube 20. In lieu of support tube 28, other well-known means may be provided to stabilize the cable 26 such as clips or other fastening means which may attach to the inner concentric surface of inner tube 20.

A control box 30 may be placed remote from the endoscope 10. The control box 30 contains some of the processing circuitry which is used to process the image signal produced by image sensor 40. Therefore, the imaging device 11 as previously defined would include the processing circuitry within control box 30 and the image sensor 40 located at the distal tip of the endoscope. Control box 30 communicates with image sensor 40 by means of cable 32 which may simply be an insulated and shielded cable which houses therein cable 26. Cable 32 is stabilized with respect to the handle portion 12 by means of a fitting 34 which ensures that cable 32 cannot be inadvertently pushed or pulled within channel 13. Additionally, an additional fitting 35 may be provided to stabilize the entry of a light cable 36 which houses the plurality of light fibers 22.

Image sensor 40 is illustrated as being a planar and square shaped member. However, the image sensor may be modified to be in a planar and circular shape to better fit within the channel defined by inner tube 20. Accordingly, FIG. 1b further shows an alternate shaped image sensor 40' which is round. A lens group or system 42 may be incorporated at the distal end of the endoscope in order to manipulate the image prior to it being impinged upon the array of pixels on the image sensor 40. This lens system 42 may be sealed at the distal end 16 of the endoscope so that the tubular portion 14 is impervious to fluids entering through the distal end 16. In the configuration of the imaging device 11 in FIGS. 1a and 1b, there are only three conductors which are necessary for providing power to the image sensor 40, and for transmitting an image from the image sensor 40 back to the processing circuitry found within control box 30. Namely, there is a power conductor 44, a grounding conductor 46, and an image signal conductor 48 each of which are hard wired to the image sensor. Thus, cable 26 may simply be a three-conductor 50 ohm cable.

Image sensor 40 can be as small as 1 mm in its largest dimension. However, a more preferable size for most endoscopic procedures would dictate that the image sensor 40 be between 4 mm to 8 mm in its largest dimension. The image signal transmitted from the image sensor through conductor 48 is also herein referred to as a pre-video signal. Once the pre-video signal has been transmitted from image sensor 40 by means of conductor 48, it is received by video processing board 50. Video processing board 50 then carries out all the necessary conditioning of the pre-video signal and places it



in a form so that it may be viewed directly on a standard video device, television or standard computer video monitor. The signal produced by the video processing board 50 can be further defined as a post-video signal which can be accepted by a standard video device. As shown in FIG. 1a, a conductor 49 is provided which transmits the post-video signal to an output connector 58 on the exterior surface of control box 30. The cable (not shown) extending from the desired video device (not shown) may receive the post-video signal by means of connector 58. Power supply board 52 may convert incoming power received through power source 54 into the desired voltage. In the preferred imager incorporated in this invention, the power to the imaging device is simply a direct current which can be a 1.5 volt to a 12 volt source. Incoming power from, for example, a wall receptacle, communicates with power supply board 52 by connector 56. Power supply board 52 takes the incoming power source and regulates it to the desired level. Additionally, ground 46 is also shown as extending back to the source of power through connector 56.

FIG. 2a illustrates a second embodiment of this invention wherein the imaging device is self-contained entirely within the distal end 16 of the endoscope, and a power source which drives the circuitry within the imaging device may come from a battery 66 housed within handle portion 12.

As shown in FIG. 2b, the video processing board 50 may be placed directly behind image sensor 40. A plurality of pin connectors 62 serve to electrically couple image sensor 40 with video processing board 50 depending upon the specific configuration of image sensor 40, pin connectors 62 may be provided either for structural support only, or to provide a means by which image signals are transmitted between image sensor 40 and board 50. When necessary, one or more supplementary boards 60 may be provided which further contain processing circuitry to process the image signal and present it in a form which may be directly received by a desired video device. The area which is occupied by image sensor 40 may be defined as the profile area of the imaging device and which determines its critical dimensions. Any imaging elements that are found on boards 50 or 60 must be able to be placed on one or more circuit boards which are longitudinally aligned with image sensor 40 along longitudinal axis XX. If the profile area is not critical in terms of limiting the largest sized imaging element within the imaging device, then the additional circuit boards 50 and 60 which are normally placed in line with image sensor 40 can be aligned in an offset manner or may be larger than the profile area of image sensor 40. In the configuration of FIG. 2b, it is desirable that elements 40, 50 and 60 be approximately the same size so that they may fit uniformly within the central channel of the endoscope. Additionally, image sensor 40 may be bonded to lens system 42 in order to provide further structural support to the imaging device 11 when mounted within the distal end 16.

Referring back to the handle portion 12 in FIG. 2a, an additional channel 64 may be provided in order that a power supply cable 68 may communicate with battery 66. Conveniently, battery 66 may itself be mounted within a well 65 formed in handle portion 12. Cable 68 carries the conductor 44 and ground 46. Cable 68 may intersect with cable 33 within channel 13, cables 68 and 33 extending then to the distal end 16. Cable 33 can be a single conductor cable which transmits the post-video signal to a desired video device. In other words, cable 33 may simply be an insulated and shielded housing for conductor 49 which carries the post-video signal. Because a preferred image sensor of the imaging device 11 may only require a 5 volt power supply,

a battery is an ideal power source in lieu of a conductor which would trail the endoscope. Accordingly, the endoscope is made more mobile and easier to handle by eliminating at least one of the trailing cables.

FIG. 3a illustrates yet another preferred embodiment of this invention, wherein the imaging device can be used in conjunction with a standard rod lens endoscope 70. As shown, rod lens endoscope 70 includes a lens train 72 which includes a plurality of highly precise lenses (not shown) which are able to transmit an image from the distal end of the endoscope, to a camera in line with the endoscope. The rod lens endoscope is equipped with a light guide coupling post 74. Light guide post 74 connects to a source of light in the form of a cable 77 having a plurality of fiber optic strands (not shown) which communicate with a source of light (not shown). The most common arrangement of the rod lens endoscope also includes a "C" or "V" mount connector 78 which attaches to the eyepiece 76. The "C" or "V" mount attaches at its other end to a camera group 80. The camera group 80 houses one or more of the elements of the imaging device. In this embodiment, the small size of the imaging device is not a critical concern since the imaging device is not being placed at the distal end of the endoscope. However, the incorporation of the imaging device in a housing which would normally hold a traditional camera still provides an advantageous arrangement. As shown, the camera group 80 may include a housing 82 which connects to a power/video cable 86. Fitting 87 is provided to couple cable 86 to the interior elements of the camera group 80 found within housing 82. FIG. 3a illustrates an arrangement of the imaging device 11 wherein the image sensor 40 is placed by itself within the housing 82 and the processing circuitry of the imaging device can be positioned in a remote control box as shown in FIG. 1a. Accordingly, only three conductors 44, 46 and 48 are necessary for providing power to the image sensor 40 and for transmitting the pre-video signal to the control box. Alternatively, as shown in FIG. 3b, the entire imaging device 11 may be incorporated within camera group 80, each of the elements of the imaging device being placed in the stacked arrangement similar to FIG. 2b. As discussed above, size is not as much of a concern in the embodiment of FIG. 3a and 3b since the camera group housing 82 is much larger than the distal tip of the endoscope of FIGS. 1a and 2a.

FIG. 3c also illustrates the use of a battery 66 which provides source of power to the imaging device in either FIG. 3a or 3b. In this arrangement, housing 82 is altered to include a battery housing 69 which houses the battery 66 therein. Battery housing 69 may include a very small diameter channel which may allow conductor 48 or 49 to communicate directly with the processing circuitry or video device, respectively. It will also be understood that the embodiment in FIG. 1a may incorporate the use of a battery 66 as the source of power. Thus, handle 12 in FIG. 1a may be altered in the same way as housing 82 to allow a battery to be attached to the handle portion 12.

FIG. 4 is a schematic diagram illustrating one way in which the imaging device 11 may be constructed. As illustrated, the image sensor 40 may include the timing and control circuits on the same planar structure. Power is supplied to image sensor 40 by power supply board 52. The connection between image sensor 40 and board 52 may simply be a cable having two conductors therein, one for ground and another for transmitting the desired voltage. These are illustrated as conductors 44 and 46. The output from image sensor 40 in the form of the pre-video signal is input to video processor board 50 by means of the conductor

48. In the configuration of FIG. 4, conductor 48 may simply be a 50 ohm conductor. Power and ground also are supplied to video processing board 50 by conductors 44 and 46 from power supply board 52. The output signal from the video processor board 50 is in the form of the post-video signal and which may be carried by conductor 49 which can also be a 50 ohm conductor.

In the first embodiment illustrated in FIG. 1a, cable 32 can be used to house conductors 44, 46 and 48. In the embodiment shown in FIG. 2a, cable 33 can be used to house conductor 49 by itself when a battery power source is used, or alternatively, cable 33 may house conductors 44, 46 and 49 if the embodiment of FIG. 2a utilizes a power source from board 52.

Optionally, a supplementary processing board 60 may be provided to further enhance the pre-video signal. As shown in FIG. 4, the supplementary board 60 may be placed such that the pre-video signal from image sensor 40 is first sent to the supplementary board and then output to the video processor board 50. In this case, the output from board 50 can be carried along conductor 51. This output can be defined as an enhanced pre-video signal. Furthermore, the post-video signal from video processor board 50 may return to the supplementary board 60 for further processing, as further discussed below. The conductor used to transmit the post-video signal back to the supplementary board is shown as conductor 59. The power supply board 52 may also provide power to the supplementary board in the same manner as to image sensor 40 and board 50. That is, a simple hard-wired connection is made onto the supplementary board for the ground and voltage carrying conductors. As discussed above, image sensor 40 may be placed remotely from boards 50 and 60. Alternatively, image sensor 40, and boards 50 and 60 each may be placed within the distal end of the endoscope.

Although FIG. 4 illustrates the image sensor and the timing and control circuits being placed on the same planar structure, it is possible to separate the timing and control circuits from the pixel array and place the timing and control circuits onto video processing board 50. The advantage in placing the timing and control circuits on the same planar structure as the image sensor is that only three connections are required between image sensor 40 and the rest of the imaging device, namely, conductors 44, 46 and 48. Additionally, placing the timing and control circuits on the same planar structure with the pixel array results in the pre-video signal having less noise. Furthermore, the addition of the timing and control circuits to the same planar structure carrying the image sensor only adds a negligible amount of size to one dimension of the planar structure. If the pixel array is to be the only element on the planar structure, then additional connections must be made between the planar structure and the video processing board 50 in order to transmit the clock signals and other control signals to the pixel array. For example, a ribbon-type cable (not shown) or a plurality of 50 ohm coaxial cables (not shown) must be used in order to control the downloading of information from the pixel array. Each of these additional connections would be hard wired between the boards.

FIG. 4a is a more detailed schematic diagram of image sensor 40 which contains an array of pixels 90 and the timing and control circuits 92. One example of a pixel array 90 which can be used within the invention is similar to that which is disclosed in U.S. Pat. No. 5,471,515 to Fossum, et al., said patent being incorporated by reference herein. More specifically, FIG. 3 of Fossum, et al. illustrates the circuitry which makes up each pixel in the array of pixels 90. The

array of pixels 90 as described in Fossum, et al. is an active pixel group with intra-pixel charged transfer. The image sensor made by the array of pixels is formed as a monolithic complementary metal oxide semiconductor integrated circuit which may be manufactured in an industry standard complementary metal oxide semiconductor process. The integrated circuit includes a focal plane array of pixel cells, each one of the cells including a photo gate overlying the substrate for accumulating the photo generated charges. In broader terms, as well understood by those skilled in the art, an image impinges upon the array of pixels, the image being in the form of photons which strike the photo diodes in the array of pixels. The photo diodes or photo detectors convert the photons into electrical energy or electrons which are stored in capacitors found in each pixel circuit. Each pixel circuit has its own amplifier which is controlled by the timing and control circuitry discussed below. The information or electrons stored in the capacitors is unloaded in the desired sequence and at a desired frequency, and then sent to the video processing board 50 for further processing.

Although the active pixel array disclosed in U.S. Pat. No. 5,471,515 is mentioned herein, it will be understood that the hybrid CCD/CMOS described above, or any other solid state imaging device may be used wherein timing and control circuits can be placed either on the same planar structure with the pixel array, or may be separated and placed remotely. Furthermore, it will be clearly understood that the invention claimed herein is not specifically limited to an image sensor as disclosed in the U.S. Pat. No. 5,471,515, but encompasses any image sensor which may be configured for use in conjunction with the other processing circuitry which makes up the imaging device of this invention.

The timing and control circuits 92 are used to control the release of the image information or image signal stored in the pixel array. In the image sensor of Fossum, et al., the pixels are arranged in a plurality of rows and columns. The image information from each of the pixels is first consolidated in a row by row fashion, and is then downloaded from one or more columns which contain the consolidated information from the rows. As shown in FIG. 4a, the control of information consolidated from the rows is achieved by latches 94, counter 96, and decoder 98. The operation of the latches, counter and decoder is similar to the operation of similar control circuitry found in other imaging devices. That is, a latch is a means of controlling the flow of electrons from each individual addressed pixel in the array of pixels. When a latch 94 is enabled, it will allow the transfer of electrons to the decoder 98. The counter 96 is programmed to count a discrete amount of information based upon a clock input from the timing and control circuits 92. When the counter 96 has reached its set point or overflows, the image information is allowed to pass through the latches 94 and be sent to the decoder 98 which places the consolidated information in a serial format. Once the decoder 98 has decoded the information and placed it in the serial format, then the row driver 100 accounts for the serial information from each row and enables each row to be downloaded by the column or columns. In short, the latches 94 will initially allow the information stored in each pixel to be accessed. The counter 96 then controls the amount of information flow based upon a desired time sequence. Once the counter has reached its set point, the decoder 98 then knows to take the information and place it in the serial format. The whole process is repeated, based upon the timing sequence that is programmed. When the row driver 100 has accounted for each of the rows, the row driver reads out each of the rows at the desired video rate.

The information released from the column or columns is also controlled by a series of latches **102**, a counter **104** and a decoder **106**. As with the information from the rows, the column information is also placed in a serial format which may then be sent to the video processing board **50**. This serial format of column information is the pre-video signal carried by conductor **48**. The column signal conditioner **108** places the column serial information in a manageable format in the form of desired voltage levels. In other words, the column signal conditioner **108** only accepts desired voltages from the downloaded column(s).

The clock input to the timing and control circuits **92** may simply be a quartz crystal timer. This clock input is divided into many other frequencies for use by the various counters. The run input to the timing and control circuit **92** may simply be an on/off control. The default input can allow one to input the pre-video signal to a video processor board which may run at a frequency of other than 30 hertz. The data input controls functions such as zoom. At least for a CMOS type active pixel array which can be accessed in a random manner, features such as zoom are easily manipulated by addressing only those pixels which locate a desired area of interest by the surgeon.

A further discussion of the timing and control circuitry which may be used in conjunction with an active pixel array is disclosed in U.S. Pat. No. 5,471,515 and is also described in an article entitled "Active Pixel Image Sensor Integrated With Readout Circuits" appearing in *NASA Tech Briefs*, October 1996, pp. 38 and 39. This particular article is also incorporated by reference.

Once image sensor **40** has created the pre-video signal, it is sent to the video processing board **50** for further processing. At board **50**, as shown in FIG. 4b, the pre-video signal is passed through a series of filters. One common filter arrangement may include two low pass filters **114** and **116**, and a band pass filter **112**. The band pass filter only passes low frequency components of the signal. Once these low frequency components pass, they are then sent to detector **120** and white balance circuit **124**, the white balance circuit distinguishing between the colors of red and blue. The white balance circuit helps the imaging device set its normal, which is white. The portion of the signal passing through low pass filter **114** then travels through gain control **118** which reduces the magnitude or amplitude of this portion to a manageable level. The output from gain control **118** is then fed back to the white balance circuit **124**. The portion of the signal traveling through filter **116** is placed through the processor **122**. In the processor **122**, the portion of the signal carrying the luminance or non-chroma is separated and sent to the Y chroma mixer **132**. Any chroma portion of the signal is held in processor **122**.

Referring to the output of the white balance circuit **124**, this chroma portion of the signal is sent to a delay line **126** where the signal is then further reduced by switch **128**. The output of switch **128** is sent through a balanced modulator **130** and also to the Y chroma mixer **132** where the processed chroma portion of the signal is mixed with the processed non-chroma portion. Finally, the output from the Y chroma mixer **132** is sent to the NTSC/PAL encoder **134**, commonly known in the art as a "composite" encoder. The composite frequencies are added to the signal leaving the Y chroma mixer **132** in encoder **134** to produce the post-video signal which may be accepted by a television.

Referring back to FIG. 4, it further illustrates supplementary board **60** which may be used to digitally enhance or otherwise further condition the pre-video signal produced

from image sensor **40**. For example, digital enhancement can brighten or otherwise clarify the edges of an image viewed on a video screen. Additionally, the background images may be removed thus leaving only the foreground images or vice versa. The connection between image sensor **40** and board **60** may simply be the conductor **48** which may also transfer the pre-video signal to board **50**. Once the pre-video signal has been digitally enhanced on supplementary board **60**, it is then sent to the video processor board **50** by means of another conductor **51**. The pre-video signal is an analog signal. The digitally enhanced pre-video signal may either be a digital signal or it may be converted back to the analog domain prior to being sent to board **50**.

In addition to digital enhancement, supplementary board **60** may further include other circuitry which may further condition the post-video signal so that it may be viewed in a desired format other than NTSC/PAL. As shown in FIGS. 4, intermediate conductor **59** may transmit the signal output from Y chroma mixer **132** back to the supplementary board **60** where the signal is further encoded for viewing in a particular format. One common encoder which can be used includes an RGB encoder **154**. The RGB encoder separates the signal into three separate colors (red, green and blue) so that the surgeon may selectively choose to view only those images containing one or more of the colors. Particularly in tissue analysis where dyes are used to color the tissue, the RGB encoder may help the surgeon to identify targeted tissue.

The next encoder illustrated in FIG. 4 is a SVHS encoder **156** (super video home system). This encoder splits or separates the luminance portion of the signal and the chroma portion of the signal prior to entering the video device. Some observers believe that a cleaner signal is input to the video device by such a separation which in turn results in a more clear video image viewed on the video device. The last encoder illustrated in FIG. 4 is a VGA encoder **158** which enables the signal to be viewed on a standard VGA monitor which is common to many computer monitors.

One difference between the arrangement of image sensor **40** and the outputs found in FIG. 3 of the Fossum, et al. patent is that in lieu of providing two analog outputs [namely, VS out (signal) and VR out (reset)], the reset function takes place in the timing and control circuitry **92**. Accordingly, the pre-video signal only requires one conductor **48**.

FIGS. 5a-5e illustrate in more detail one example of circuitry which may be used in the video processing board **50** in order to produce a post-video signal which may be directly accepted by a video device such as a television. The circuitry disclosed in FIGS. 5a-5e is very similar to circuitry which is found in a miniature quarter-inch Panasonic camera, Model KS-162. It will be understood by those skilled in the art that the particular arrangement of elements found in FIGS. 5a-5e are only exemplary of the type of video processing circuitry which may be incorporated in order to take the pre-video signal and condition it to be received by a desired video device.

As shown in FIG. 5a, 5 volt power is provided along with a ground by conductors **44** and **46** to board **50**. The pre-video signal carried by conductor **48** is buffered at buffer **137** and then is transferred to amplifying group **138**. Amplifying group **138** amplifies the signal to a usable level as well as achieving impedance matching for the remaining circuitry.

The next major element is the automatic gain control **140** shown in FIG. 5b. Automatic gain control **140** automatically controls the signal from amplifying group **138** to an accept-



able level and also adds other characteristics to the signal as discussed below. More specifically, automatic gain control **140** conditions the signal based upon inputs from a **12** channel digital to analog converter **141**. Converter **141** retrieves stored information from EEPROM (electrically erasable programmable read only memory) **143**. EEPROM **143** is a non-volatile memory element which may store user information, for example, settings for color, tint, balance and the like. Thus, automatic gain control **140** changes the texture or visual characteristics based upon user inputs. The signal leaving the automatic gain control **140** is an analog signal until being converted by analog to digital converter **142**.

Digital signal processor **144** of FIG. 5c further processes the converted signal into a serial type digital signal. One function of the microprocessor **146** is to control the manner in which digital signal processor **144** sorts the digital signals emanating from converter **142**. Microprocessor **146** also controls analog to digital converter **142** in terms of when it is activated, when it accepts data, when to release data, and the rate at which data should be released. Microprocessor **146** may also control other functions of the imaging device such as white balance. The microprocessor **146** may selectively receive the information stored in the EEPROM **143** and carry out its various commands to further control the other elements within the circuitry.

After the signal is processed by digital signal processor **144**, the signal is sent to digital encoder **148** illustrated in FIG. 5d. Some of the more important functions of digital encoder **148** are to encode the digital signal with synchronization, modulated chroma, blanking, horizontal drive, and the other components necessary so that the signal may be placed in a condition for reception by a video device such as a television monitor. As also illustrated in FIG. 5d, once the signal has passed through digital encoder **148**, the signal is reconverted into an analog signal through digital to analog converter **150**.

This reconverted analog signal is then buffered at buffers **151** and then sent to amplifier group **152** of FIG. 5e which amplifies the signal so that it is readily accepted by a desired video device. Specifically, as shown in FIG. 5e, one SVHS outlet is provided at **160**, and two composite or NTSC outlets are provided at **162** and **164**, respectively.

From the foregoing, it is apparent that an entire imaging device may be incorporated within the distal tip of an endoscope, or may have some elements of the imaging device being placed in a small remote box adjacent to the endoscope. Based upon the type of image sensor used, the profile area of the imaging device may be made small enough to be placed into an endoscope which has a very small diameter tube. Additionally, the imaging device may be placed into the channels of existing endoscopes to provide additional imaging capability without increasing the size of the endoscope. The imaging device may be powered by a standard power input connection in the form of a power cord, or a small lithium battery may be used.

This invention has been described in detail with reference to particular embodiments thereof, but it will be understood that various other modifications can be effected within the spirit and scope of this invention.

What is claimed is:

1. A reduced area imaging device comprising:

an imager sensor lying in a first plane and including an array of CMOS pixels for receiving images thereon, said image sensor further including circuitry means on said first plane and coupled to said array of CMOS

pixels for timing and control of said array of CMOS pixels, said image sensor producing a pre-video signal;

a pre-video conductor for transmitting said pre-video signal, said pre-video conductor having first and second ends, said first end communicating with said image sensor;

a first circuit board lying in a second plane and longitudinally aligned with said image sensor, said first circuit board being connected to said pre-video conductor at said second end thereof, said first circuit board including circuitry means for converting said pre-video signal to a post-video signal for direct reception by a standard video device;

a power supply electrically coupled with said image sensor for driving said array of pixels and said timing and control means, and electrically coupled to said first circuit board for driving said circuit board; and

a non-removable lens integral with said imaging device for focusing images on said image sensor.

2. A reduced area imaging device, as claimed in claim 1, wherein:

said image sensor defines a profile area in said first plane, and said first circuit board being positioned so as not to extend substantially beyond said profile area.

3. A reduced area imaging device, as claimed in claim 1, further including:

a second circuit board electrically coupled with said first circuit board and said image sensor for enhancing said pre-video signal prior to reception by said first circuit board, said second circuit board being longitudinally aligned with said first circuit board and said image sensor so as not to extend substantially beyond said profile area.

4. A reduced area imaging device, as claimed in claim 1, wherein:

said first and second planes are offset from and substantially parallel to one another.

5. A reduced area imaging device, as claimed in claim 3, wherein:

said second circuit board lies in a third plane which is offset from and extends substantially parallel to said first and second planes.

6. A reduced area imaging device comprising:

an image sensor lying in a first plane and including an array of CMOS pixels for receiving images thereon, said image sensor further including circuitry means on said first plane and coupled to said array of CMOS pixels for timing and control of said array of CMOS pixels, said image sensor producing a pre-video signal;

a control box remote from said image sensor, said control box including circuitry means for receiving said pre-video signal from said image sensor, and for converting said pre-video signal to a post-video signal which may be received by a standard video device;

a power supply coupled to said control box and said image sensor for providing power thereto; and

a non-removable lens integral with said imaging device for focusing images on said image sensor.

7. A reduced area imaging device, as claimed in claim 6, wherein said control box further includes:

a supplementary circuit board for digitally enhancing the pre-video signal, said supplementary circuit board coupled to said circuitry means for receiving said pre-video signal and for converting said pre-video signal.

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8. A reduced area imaging device, as claimed in claim 1, wherein said array of CMOS pixels further includes:

an array of passive CMOS pixels, wherein individual passive CMOS pixels of said array of passive CMOS pixels each includes a photo diode for producing photoelectrically generated signals and an access transistor communicating with said photo diode to control the release of said photoelectrically generated signals.

9. A reduced area imaging device comprising:

an array of CMOS pixels defining a profile area and lying in a first plane, said array of CMOS pixels for receiving images thereon;

a circuit board longitudinally aligned with and electrically coupled to said array of CMOS pixels, said circuit board lying in a second plane which is offset from said first plane and substantially parallel to said first plane, said circuit board including circuitry means for timing and control of said array of CMOS pixels, said timing and control means producing a pre-video signal, said circuit board further including circuitry means for receiving said pre-video signal from said timing and control means and converting said pre-video signal to a post-video output signal for direct reception by a video device;

a power supply electrically coupled to said array of said CMOS pixels and said circuit board; and

a non-removable lens integral with said imaging device for focusing images on said image sensor.

10. A reduced area imaging device, as claimed in claim 9 wherein:

said array of CMOS pixels includes an array of passive CMOS pixels.

11. A reduced area imaging device, as claimed in claim 9, further including:

a supplementary circuit board communicating with said array of CMOS pixels and said circuit board for enhancing said pre-video signal, said supplementary circuit board being longitudinally aligned with said array of CMOS pixels and said circuit board, and being positioned so as not to extend substantially beyond said profile area.

12. An endoscope with integral imaging capability for producing images to be viewed on a video device, said endoscope comprising:

a tubular portion including a distal end, a proximal end and a central passageway extending therethrough; means for providing light to said distal end to illuminate a surgical site;

a CMOS image sensor lying in a first plane and positioned at said distal end of said tubular portion for receiving images of the surgical site, said CMOS image sensor defining a profile area, and said CMOS image sensor producing an image signal;

circuitry means electrically coupled to said CMOS image sensor for timing and control of said CMOS image sensor, said circuitry means for timing and control placed within said tubular portion;

a video processor board lying in a second plane spaced from and longitudinally aligned with said CMOS image sensor within said tubular portion and adjacent said distal end thereof and communicating with said CMOS image sensor to receive said image signal, said video processor board including circuitry means for processing said image signal and converting said image signal to a post-video signal for direct reception by the

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video device, said video processor board being positioned so as not to extend substantially beyond said profile area; and

a power supply electrically coupled to said CMOS image sensor and said video processor board.

13. An endoscope, as claimed in claim 12, wherein:

said CMOS image sensor includes an array of CMOS pixels, and wherein individual CMOS pixels within said array of CMOS pixels each includes an amplifier.

14. An endoscope, as claimed in claim 12, wherein:

said CMOS image sensor includes a plurality of passive CMOS pixels.

15. An endoscope, as claimed in claim 12, wherein:

said CMOS image sensor includes a plurality of passive CMOS pixels, and wherein individual passive CMOS pixels of said plurality of passive CMOS pixels each includes a photo diode for producing photoelectrically generated signals, and an access transistor communicating with said photo diode to control the release of said photoelectrically generated signals.

16. An endoscope, as claimed in claim 12, wherein:

said circuitry means for timing and control is placed on said first plane adjacent said CMOS image sensor.

17. An endoscope, as claimed in claim 12, wherein:

said circuitry means for timing and control is placed on said second plane adjacent said circuitry means for processing and converting.

18. An endoscope, as claimed in claim 12, further including:

a handle connected to said proximal end of said tubular portion for grasping by surgeon.

19. An endoscope, as claimed in claim 12, further including:

a lens positioned at said distal end of said tubular portion and distally of said CMOS image sensor for producing a modified image on said CMOS image sensor.

20. An endoscope, as claimed in claim 12, wherein:

said power supply is a battery attached to said handle.

21. An endoscope, as claimed in claim 12, wherein:

said second plane is offset from and substantially parallel to said first plane.

22. An endoscope comprising:

a tubular portion including a central passageway extending therethrough, a proximal end and a distal end;

a CMOS image sensor positioned at said distal end of said tubular portion for receiving images of a surgical site, said CMOS imager defined by an array of CMOS pixels and, said CMOS imager lying in a first plane; circuitry means for timing and control of said CMOS image sensor placed adjacent to said CMOS image sensor on said first plane;

a control box remote from said tubular portion and coupled to said CMOS image sensor, said control box including circuitry means for receiving a pre-video signal from said CMOS image sensor, and for converting said pre-video signal to a post-video signal which may be received by a standard video device; and

a power supply coupled to said control box and said CMOS image sensor for providing power thereto.

23. An endoscope, as claimed in claim 22, wherein:

said power supply is located in said control box.

24. An endoscope, as claimed in claim 22, further including:

a handle connected to said proximal end of said tubular portion for grasping by a surgeon.

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25. An endoscope, as claimed in claim 22, further including:  
 a supplementary circuit board for digitally enhancing said pre-video signal, said supplementary circuit board electrically coupled to said circuitry means for receiving and converting. 5
26. An endoscope, as claimed in claim 22, further including:  
 a lens positioned at said distal end of said tubular portion of sensor. 10
27. An endoscope, as claimed in claim 22, wherein:  
 said power supply is a battery attached to said handle.
28. A reduced area imaging device comprising:  
 an array of CMOS pixels defining a profile area and lying in a first plane, said array of said CMOS pixels for receiving images thereon; 15
- a circuit board longitudinally aligned with and electrically coupled to said array of CMOS pixels, said circuit board lying in a second plane which is offset from said first plane and substantially parallel to said first plane, said circuit board including timing and control means for controlling the release of information from said array of CMOS pixels, said timing and control means producing a pre-video signal; 20
- a control box remote from said array of said CMOS pixels and said circuit board, said control box including circuitry means for receiving said pre-video signal, and for converting said pre-video signal to a post-video signal which may be received by a standard video device; 25 30

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- a power supply coupled to said control box, said array of CMOS pixels and said timing and control means for providing power thereto; and  
 a non-removable lens integral with said imaging device for focusing images on said array of CMOS pixels.
29. A reduced area imaging device, as claimed in claim 28, wherein said array of CMOS pixels further includes:  
 an array of passive CMOS pixels, wherein individual passive CMOS pixels of said array of passive CMOS pixels each includes a photo diode for producing photoelectrically generated signals; and  
 an access transistor communicating with said photo diode to control the release of said photoelectrically generated signals.
30. A reduced area imaging device, as claimed in claim 28, wherein said array of CMOS pixels further includes:  
 an array of active CMOS pixels, wherein individual active CMOS pixels within said array of active CMOS pixels each includes an amplifier.
31. An endoscope, as claimed in claim 22, wherein:  
 individual pixels within said array of CMOS pixels each include an amplifier.
32. An endoscope, as claimed in claim 22, wherein:  
 said array of CMOS pixels includes a plurality of passive CMOS pixels, and wherein individual passive CMOS pixels of said plurality of passive CMOS pixels each include a photo diode for producing photo electrically generated signals, and an access transistor communicating with said photo diode to control the release of said photo electrically generated signals.

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