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Vaccarelli

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(54) **MICROSCOPY LABORATORY SYSTEM**

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(52) **U.S. Cl.** **345/2.2**
(58) **Field of Search** 434/350, 351, 434/362, 432, 433; 359/368, 363; 382/128; 348/79, 80; 396/432; D16/131; 345/1.2, 1.3, 2.1, 2.2

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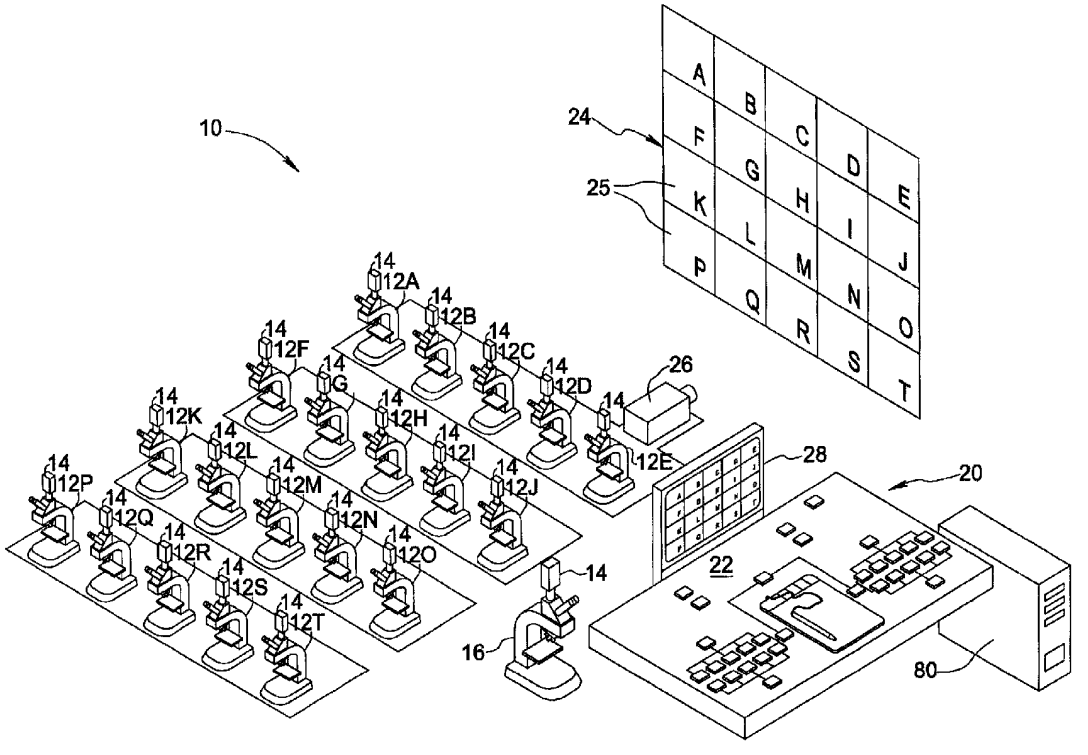
(57) **ABSTRACT**

A microscopy laboratory system for efficient instruction is disclosed. The system comprises a plurality of student microscopes each equipped with a camera for generating an image signal representing a student view image of at least a portion of the field of view of the student microscope, multiplexed control means connected by video cables or wireless technology to the cameras to provide a composite instruction image signal based on student view images from one or more selected microscopes, and a projection unit or other public display for presenting the instruction image to the students in the laboratory. An instructor microscope can also be coupled into the system, and a display image marker is preferably linked to the multiplexed control means for inserting instructor annotations into the displayed instruction image.

19 Claims, 5 Drawing Sheets



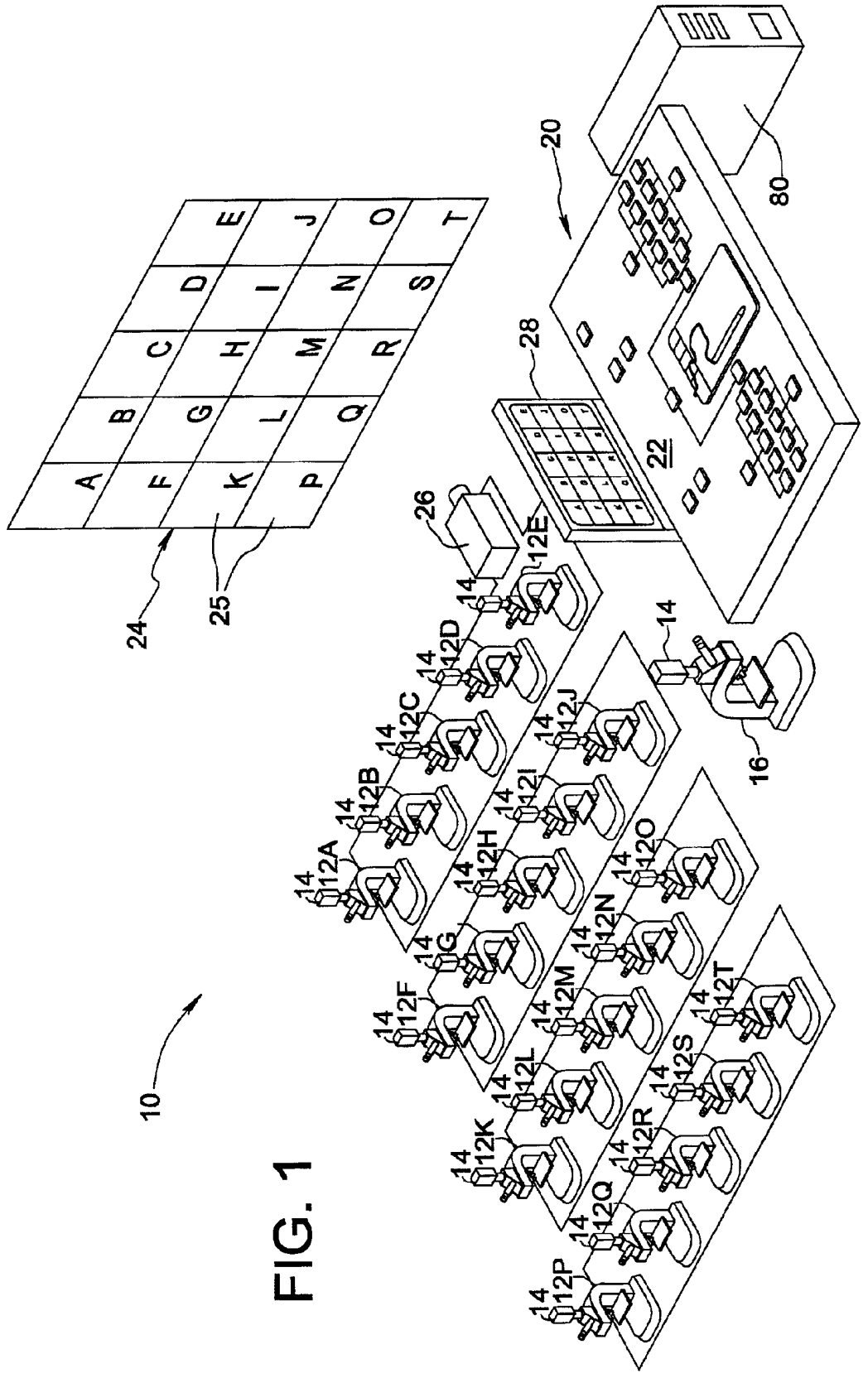

A B C D E
F G H I J
K L M N O
P Q R S T
24
25
10
20
22
28
26
80
16
12A
12B
12C
12D
12E
12F
G
12H
12I
12J
12K
12L
12M
12N
12O
12P
12Q
12R
12S
12T
14

FIG. 1

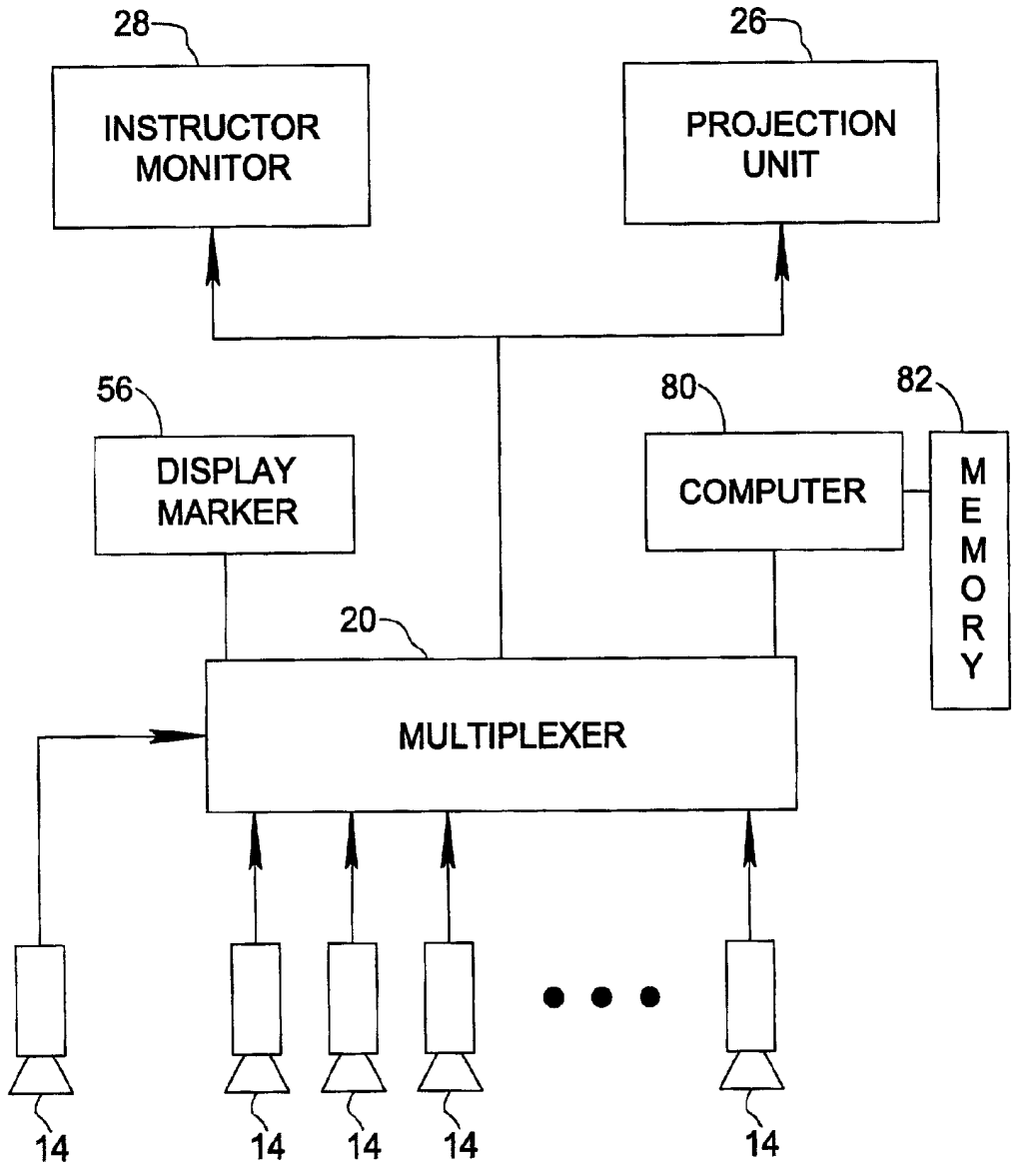

28
INSTRUCTOR MONITOR
26
PROJECTION UNIT
56
DISPLAY MARKER
80
COMPUTER
82
MEMORY
20
MULTIPLEXER
14
14
14
14
14

FIG. 2

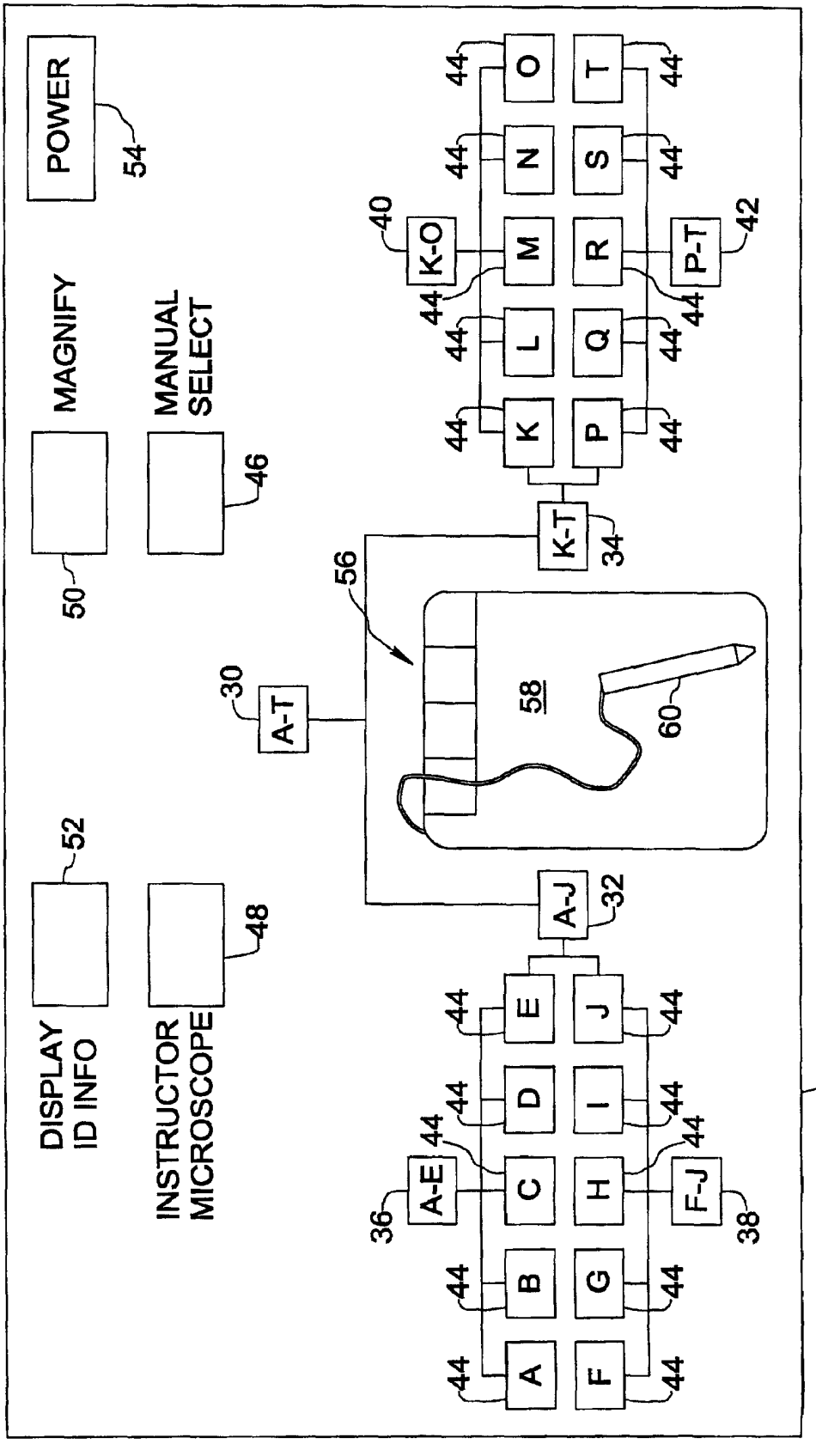

POWER
54
MAGNIFY
MANUAL SELECT
46
50
DISPLAY ID INFO
52
INSTRUCTOR MICROSCOPE
48
56
58
60
30
A-T
K-T
34
A-J
32
A-E
36
F-J
38
40
K-O
42
P-T
44
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
S
T
22

FIG. 3

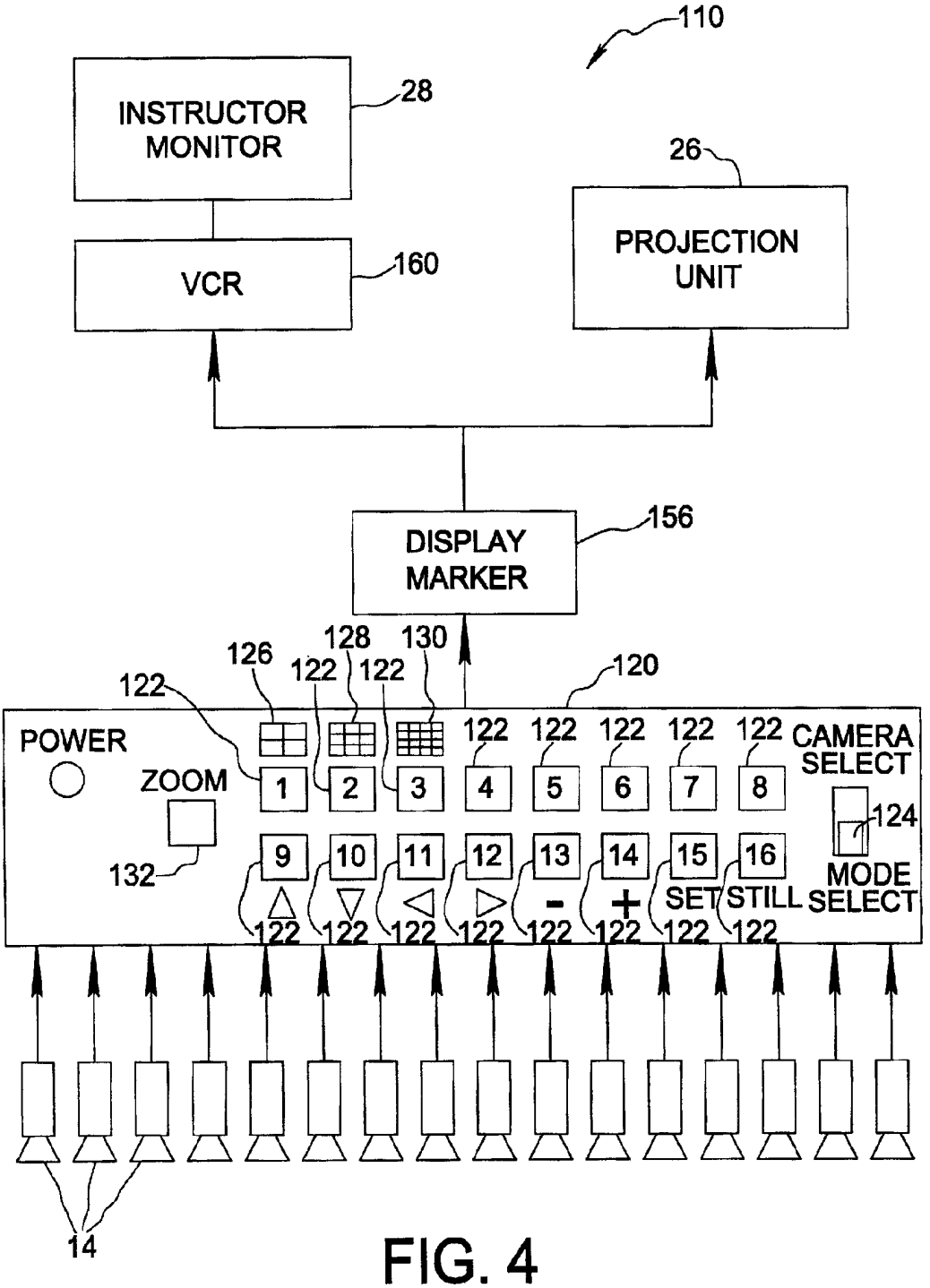

110
INSTRUCTOR MONITOR
28
26
PROJECTION UNIT
VCR
160
DISPLAY MARKER
156
126
128
130
122
120
POWER
ZOOM
CAMERA SELECT
124
MODE SELECT
SET
STILL
132
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
14

FIG. 4

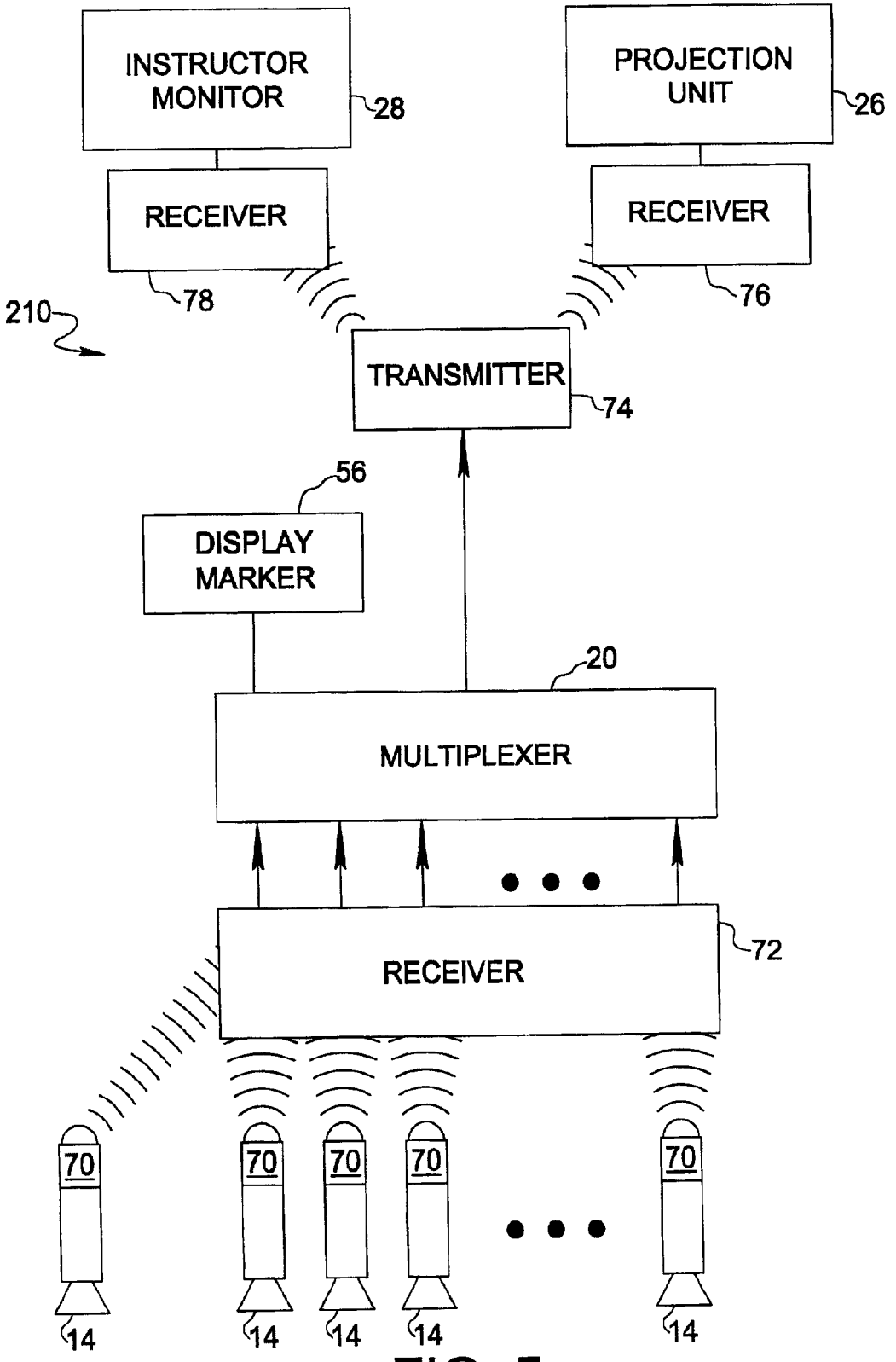

INSTRUCTOR MONITOR
28
PROJECTION UNIT
26
RECEIVER
RECEIVER
78
76
210
TRANSMITTER
74
56
DISPLAY MARKER
20
MULTIPLEXER
RECEIVER
72
70
70
70
70
70
14
14
14
14
14

FIG. 5

MICROSCOPY LABORATORY SYSTEM

BACKGROUND OF THE INVENTION

The present invention relates generally to instructional settings wherein participants view specimens through respective microscopes, and more particularly to a microscopy laboratory system wherein an instructor and students can view an overall instructional image that selectively includes images from the field of view of one, some, or all of the microscopes in the laboratory.

Microscopy laboratories at universities, teaching hospitals, etc. are known to include a television monitor or projection unit that receives an image signal from a camera mounted on the instructor's microscope, such as by a C-mount, trinocular viewing body, video module, or the like. In this way, each student in the laboratory can view an image that serves as a model to help him or her position a like specimen on his or her own microscope and to adjust the specimen location, objective power, focus, illumination, filters and other parameters of the microscope in an effort to match the displayed image from the field of view of the instructor's microscope. In this type of system, it is also known to provide a marking device that allows the instructor to annotate the displayed image from his or her microscope. Absent this technology, a photograph in a textbook is often used as a model. A drawback of this system is that the instructor cannot see what the students are viewing through their own microscopes. Often, the instructor must walk around the laboratory and look through each student's microscope to make sure every student in the laboratory is viewing a proper image, or the instructor must walk over to a particular student's station whenever a question arises. Clearly, this type of system is inefficient because the instructor must spend time checking the student microscopes rather than instructing the students. Another drawback is that the instructor has no means to annotate an image from a student's microscope to better provide constructive criticism or positive reinforcement.

BRIEF SUMMARY OF THE INVENTION

Therefore, it is an object of the present invention to provide an improved microscopy laboratory system that allows an instructor and students to simultaneously see images from the field of view of one, some, or all of the student microscopes as desired.

It is another object of the present invention to provide an improved microscopy laboratory system that allows an instructor to annotate images from the field of view of the instructor's microscope and any student's microscope for instructional purposes.

These and other objects are achieved by a microscopy laboratory system according to the present invention. The system comprises a plurality of student microscopes each having a camera, for example a digital video camera, coupled thereto for generating an image signal representing a student view image of at least a portion of the field of view of the student microscope. The system also comprises multiplexed control means connected by video cables or wireless technology to the cameras to receive the respective image signals, and a display means such as a projection unit, one or more shared viewing monitors, or individual student viewing monitors connected to the multiplexed control means for presenting an instruction image to the students in the laboratory. The multiplexed control means enables an instructor to select a set of image signals that will make up the publicly displayed instruction image. Where more than one image signal is selected, the instruction image is divided into smaller image windows corresponding to the selected image signals. The selected set of image signals can be a set of one image signal, a set of image signals corresponding to one of a plurality of predefined sub-groups of image signals, a sub-group of image signals chosen by the instructor, or a set of all the available image signals.

The microscopy laboratory system preferably comprises an instructor microscope equipped with a camera that is also connected to supply an image signal to the multiplexed control means, whereby the instruction image can include an instructor view image. A dedicated instructor monitor is preferably provided for presenting the instruction image to the instructor. The system also preferably comprises a display image marker connected to the multiplexed control means for enabling the instructor to annotate the instruction image seen by the students, and a computer linked to the multiplexed control means for storage, retrieval, and enhancement of images.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

The nature and mode of operation of the present invention will now be more fully described in the following detailed description of the invention taken with the accompanying drawing figures, in which:

FIG. **1** is a general schematic view of a microscopy laboratory system formed in accordance with an embodiment of the present invention;

FIG. **2** is a block diagram showing connections between hardware components of the microscopy laboratory system shown in FIG. **1**;

FIG. **3** is a plan view of a user interface of a multiplexer control means of the embodiment shown in FIG. **1**;

FIG. **4** is schematic diagram of a microscopy laboratory system formed in accordance with another embodiment of the present invention utilizing a commercially available multiplexer; and

FIG. **5** is a schematic diagram of a microscopy laboratory system formed in accordance with another embodiment of the present invention utilizing wireless signal communication.

DETAILED DESCRIPTION OF THE INVENTION

Referring initially to FIGS. **1** and **2** of the drawings, a microscopy laboratory system formed in accordance with a first embodiment of the present invention is generally identified by reference numeral **10**. Microscopy laboratory system **10** comprises a plurality of student microscopes **12A–12T** each equipped with a video camera **14** for generating an image signal representing a student view image of at least a portion of the field of view of the corresponding student microscope, and an instructor microscope **16** likewise equipped with a camera **14** for generating an image signal representing an instructor view image of at least a portion of the field of view of instructor microscope **16**. Cameras **14** are preferably video cameras that are either retro-fitted to or integrated with the microscope through a C-mount, a trinocular viewing body attachment, or an integrated video module inserted between the microscope stand and the binocular tube of the microscope. By way of non-limiting example, the Leica IC A and Leica ICC A video modules available from Leica Microsystems Inc. are suit-

able for practicing the present invention with various specified microscope models available from the same supplier.

Microscopy laboratory system **10** further comprises multiplexed control means **20** connected to cameras **14** for receiving image signals as input, enabling an instructor to select a set of the received image signals for display as output, and generating an instruction image signal based on the selected set of image signals. In the embodiment of FIGS. **1** and **2**, multiplexed control means **20** is a video multiplexer configured with a custom user interface **22**, for example a user interface as shown in FIG. **3**, that allows the instructor to establish a suitable instruction image **24** as will be described below. Multiplexed control means **20** could also be a digital image multiplexer, depending on the format of the image signals from cameras **14**.

The instruction image signal from multiplexed control means **20** is communicated to a suitable public display device, such as a projection unit **26** connected to the multiplexed control means, so that all students can simultaneously view instruction image **24**. As an alternative to projecting instruction image **24** for public viewing, it is of course possible to provide one or several shared viewing monitors, and it is also possible to provide each student microscope station with its own viewing means, such as a small video monitor or display unit (not shown) connected to receive output from multiplexed control means **20**. An instructor monitor **28** is preferably provided in the vicinity of user interface **22** for facilitating ergonomically agreeable viewing of instruction image **24** by the instructor.

User interface **22** shown in FIG. **3** generally comprises a bracketed button system that enables the instructor to compose a suitable instruction image **24** by choosing a set of image signals corresponding to view images which the instructor wishes to include in the instruction image. Selection of button **30** results in an instruction image **24** like that illustrated in FIG. **1**, in which the instruction image is divided into a plurality of smaller image windows **25** such that all of the student view images from student microscopes **12**A–**12**T are presented in the instruction image. Selection of button **32** yields an instruction image containing only student view images from student microscopes **12**A–**12**J, while selection of button **34** yields an instruction image containing only student view images from student microscopes **12**K–**12**T. Instruction image **24** can be restricted to further subgroups of student view images by selection of button **36** corresponding to student microscopes **12**A–**12**E, button **38** corresponding to student microscopes **12**F–**12**J, button **40** corresponding to student microscopes **12**K–**12**O, or button **42** corresponding to student microscopes **12**P–**12**T. Instruction image **24** can also be limited to a single student view image from a chosen student microscope by pressing any one of buttons **44**. A MANUAL SELECT button **46** is preferably provided to allow the instructor to compose an instruction image that differs from one of the predetermined subgroups associated with buttons **32**, **34**, **36**, **38**, **40**, and **42**. With MANUAL SELECT button **46** depressed, the instructor can then select more than one button **44** to choose the desired student view images. The instructor may also present an instruction image corresponding to the image signal from instructor microscope **16** using INSTRUCTOR MICROSCOPE button **48**. An image magnification function is preferably provided and is accessed through MAGNIFY button **50**. If desired, identifying indicia **27** are superimposed in each image window **25** to indicate the particular microscope associated with the image window by pressing DISPLAY ID INFO button **52**. User interface **22** is also shown as including a POWER button **54**.

Microscopy laboratory system **10** further comprises a display image marker **56** connected to the multiplexed control means **20** for enabling the instructor to annotate instruction image **24**, and a computer **80** having memory **82** also connected to the multiplexed control means for storing instruction image **24** and/or student view images from microscopes **14** and/or an instructor view image. Display image marker **56** can be a video marking system that takes input from a digitizing tablet **58** and accompanying pen **60**, and/or from other input sources such as a keyboard, light pen, or touch screen, and superimposes markings on instruction image **24**. Display image marker **56** can be integrated with multiplexed control means **20**, as shown, or can be connected as a stand-alone portion of the system. As will be appreciated, display image marker **56** gives the instructor considerable power to highlight important image features to all students, highlight problems with a particular student view image, and emphasize positive aspects a particular student view image. Computer **80** can be used to store images to and retrieve images from memory **82**, and to enhance images using available software.

FIG. **4** shows an embodiment of the present invention wherein a microscopy laboratory system **110** is configured using an existing "off the shelf" video multiplexer **120**. Video multiplexer **120** is a PANASONIC® WJ-FS216 Digital Video Simplex Multiplexer having sixteen camera inputs for receiving image signals from sixteen cameras **14**, one camera being coupled with an instructor microscope and the remaining fifteen cameras being coupled with respective student microscopes. Buttons **122** on multiplexer **120** allow the image signal from a particular camera to be selected when toggle **124** is switched to a "CAMERA SELECT" position. Certain of the buttons **122** have a dual function that is enabled when toggle **124** is switched to a "MODE SELECT" position as shown in FIG. **4**. More specifically, the buttons for the first through third cameras each have a second mode for providing a multi-window display of four, nine, and sixteen image windows, as indicated by icons **126**, **128**, and **130**, respectively. A ZOOM button **132** for magnifying instruction image **24** is also provided.

Microscopy laboratory system **110** also includes a commercially available display image marker **156**. The POINTMAKER® PVI-44 Video Marker available from Boeckeler Instruments, Inc. is suitable for practicing the present invention. Display image marker **156** is connected by standard video cable to receive an output image signal from multiplexer **120**. A final instruction image signal, including any annotations added by way of display image marker **156**, is supplied to projection unit **26** and to an optional videocassette recorder **160** operatively associated with instructor monitor **28**. Consequently, it is possible to record instructional lessons and observed microscopic processes for future use.

The embodiments described above rely on video cables for transmitting image signals between components. In situations where extensive cabling is impractical, unsafe, or otherwise undesirable, it is contemplated to provide wireless connections enabling transmission of image signals from cameras **14** to multiplexed control means **20**, and from multiplexed control means **20** to projection unit **26** or to individual or shared student viewing monitors. FIG. **5** shows a microscopy laboratory system **210** that is generally similar to systems **10** and **110** described above, however cameras **14** are with transmitters **70** for transmitting the image signals to a multi-channel receiver **72** connected to multiplexed control means **20**. In addition, a transmitter **74** is operatively connected to multiplexed control means **20** and communi-

cates with corresponding receivers **76** and **78** linked to projection unit **26** and instructor monitor **28**, respectively. Receivers **72**, **76** and **78** and transmitters **70** and **74** can be analog wireless communication devices or digital wireless communication devices, depending upon system requirements.

What is claimed is:

1. A microscopy laboratory system comprising:

a plurality of student microscopes;

a plurality of cameras associated one with each of said plurality of student microscopes for generating an image signal representing a student view image of at least a portion of the field of view of said student microscope;

multiplexed control means connected to said plurality of cameras for receiving said image signals and enabling an instructor to select a set of said image signals for display, wherein said multiplexed control means generates an instruction image signal generated from said selected set of image signals; and

display means connected to said multiplexed control means for receiving said instruction image signal and displaying an instruction image comprising student view images corresponding to said selected set of image signals; and

a display image marker means connected to said multiplexed control means for enabling said instructor to annotate said instruction image.

2. The microscopy laboratory system according to claim **1**, further comprising an instructor microscope and a camera for generating an image signal representing an instructor view image of at least a portion of the field of view of said instructor microscope, wherein said multiplexed control means is connected to said camera associated with said instructor microscope to receive said image signal generated thereby, whereby said instruction image optionally comprises said instructor view image.

3. The microscopy laboratory system according to claim **1**, wherein said multiplexed control means allows said instructor to select all of said image signals from said cameras associated with said plurality of student microscopes as said selected set.

4. The microscopy laboratory system according to claim **2**, wherein said multiplexed control means allows said instructor to select all of said image signals from said cameras associated with said plurality of student microscopes as said selected set.

5. The microscopy laboratory system according to claim **1**, wherein said multiplexed control means allows said instructor to select said image signal from said camera associated with any one of said plurality of student microscopes as said selected set.

6. The microscopy laboratory system according to claim **2**, wherein said multiplexed control means allows said instructor to select said image signal from said camera associated with any one of said plurality of student microscopes as said selected set.

7. The microscopy laboratory system according to claim **1**, wherein said multiplexed control means allows said instructor to select said image signals from cameras of a predetermined sub-group of said plurality of student microscopes as said selected set.

8. The microscopy laboratory system according to claim **2**, wherein said multiplexed control means allows said instructor to select said image signals from cameras of a predetermined sub-group of said plurality of student microscopes as said selected set.

9. The microscopy laboratory system according to claim **7**, wherein there is a plurality of different predetermined sub-groups of said student microscopes.

10. The microscopy laboratory system according to claim **8**, wherein there is a plurality of different predetermined sub-groups of said student microscopes.

11. The microscopy laboratory system according to claim **2**, wherein said multiplexed control means allows said instructor to select said image signal from said camera associated with said instructor microscope as said selected set.

12. The microscopy laboratory system according to claim **1**, further comprising a computer connected to said multiplexed control means, said computer having a memory, whereby said instruction image and said student view images can be stored in and retrieved from said memory.

13. The microscopy laboratory system according to claim **2**, further comprising a computer connected to said multiplexed control means, said computer having a memory, whereby said instruction image, said student view images, and said instructor view image can be stored in and retrieved from said memory.

14. The microscopy laboratory system according to claim **1**, wherein said multiplexed control means comprises means for selectively superimposing respective identification information on each said student view image in said instruction image.

15. The microscopy laboratory system according to claim **2**, wherein said multiplexed control means comprises means for selectively superimposing respective identification information on each said student view image in said instruction image.

16. The microscopy laboratory system according to claim **1**, wherein said multiplexed control means comprises means for magnifying said instruction image.

17. The microscopy laboratory system according to claim **2**, wherein said multiplexed control means comprises means for magnifying said instruction image.

18. The microscopy laboratory system according to claim **1**, wherein said connection between said multiplexed control means and said plurality of cameras comprises a wireless connection.

19. The microscopy laboratory system according to claim **1**, wherein said connection between said display means and said multiplexed control means comprises a wireless connection.

* * * * *