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(54) Title: CONSTRUCTION OF A CAMERA HAVING A REDUCED NUMBER OF COMPONENTS

(57) Abstract: Cameras (30) having a reduced number of components as compared to known cameras, and methods of manufacturing such cameras. In accordance with one or more embodiments of the invention, the total number of components in a camera (30) may be reduced by providing components that provide multiple functions. For example, the lead frame (32) may be used as both the housing for the camera and as a mount for the image sensor (50). Additionally, the lead frame (32) may provide a simple focus mechanism that can translate the lens (64) with respect to the rest of the lead frame (32). Thus, embodiments of the invention reduce components of cameras by at least providing a multi-function lead frame (32) that serves as the housing for the camera (30), a mount for the image sensor (50), and a focus mechanism (44, 46). Other embodiments such as a clear coating to cover and protect the image sensor (50) also reduce the number of components and reduce manufacturing costs.

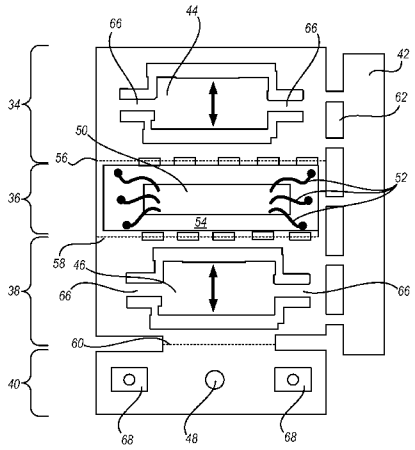

FIG. 3A

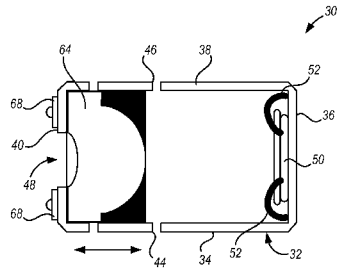

FIG. 4A

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CONSTRUCTION OF A CAMERA HAVING A REDUCED NUMBER OF COMPONENTS

PRIORITY CLAIM

[0001] This application claims priority to New Zealand Provisional Patent Application No. 571,682, filed on October 2, 2008 and entitled "Construction of a Reduced Parts Count Camera," which is hereby incorporated by reference herein in its entirety.

TECHNICAL FIELD

[0002] The present subject matter pertains to the construction of cameras.

BACKGROUND

[0003] Known camera assemblies are typically constructed from several different components. For example, the parts of a typical camera assembly 10 shown in FIG. 1 and FIG. 2 include an aperture 2, a lens 4, a focus mechanism 6, a housing 8, an image sensor 12, a lead frame 14, connecting wires 18, and a window 20 to cover the image sensor 12. The image sensor 12 can be based on complementary metal oxide semiconductor (CMOS), charge coupled device (CCD), or charge injection device (CID) technologies, or any other sensor technology capable of detecting changes in light and electromagnetic radiation. The image sensor 12 may have a one-dimensional or a two-dimensional array of pixels.

[0004] Connecting wires 18 may connect the image sensor 12 directly or indirectly to a processor, *e.g.*, a digital signal processor or the processor of a general or specialized computing device. For example, the connecting wires 18 may be connected to a circuit board, a communication bus, an interface adapter or other suitable connector. Window 20 covers and protects the image sensor 12. The window 20 is separately formed (e.g., cast,

molded, extruded, etc.) or is selected from a set of windows having various sizes in order to fit the specific dimensions of the image sensor 12.

[0005] In the typical camera assembly 10, each one of the above-described components serves a single function, and no components have multiple functions. In other words, there is a first component that comprises the lens 4, a second component that comprises the focus mechanism 6, a third component that comprises the housing 8, and so on. Methods used to construct these cameras are relatively labor intensive and expensive because there are so many separate components. Accordingly, there is a need for a camera having a reduced number of components as compared to known cameras, and furthermore, for methods of manufacturing cameras having a reduced number of components.

SUMMARY

[0006] Objects and advantages of the present subject matter will be apparent to one of ordinary skill in the art upon careful review of the present disclosure and/or practice of one or more embodiments of the claimed subject matter.

[0007] In accordance with one or more embodiments of the invention, the total number of components in a camera assembly may be reduced by providing components that serve multiple functions. For example, in some embodiments the lead frame may not only be used as a mount for the image sensor, but also as the housing for the image sensor. Specifically, a sheet of material including but not limited to metal may be cut or stamped to form the lead frame. The lead frame has sections that may be folded to form a housing for the camera.

[0008] Also, the lead frame may provide a mechanism for mounting and focus the lens of the camera assembly. For example, at least one focus section may be cut or stamped

into the sheet of material that comprises the lead frame. The focus section can translate with respect to the rest of the lead frame. When the lead frame is folded into the housing, a lens may be mounted on the focus section. The lens may be focused by moving the lens (which is mounted to the focus section) closer to or further away from the image sensor.

[0009] Thus, embodiments described herein reduce components of camera assemblies by providing a multi-function lead frame that not only serves as a mount for the image sensor, but also as a housing for the camera assembly and a focus mechanism. Other embodiments—such as a clear coating to cover and protect the image sensor—may also reduce the number of components and reduce manufacturing costs.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] A full and enabling disclosure including the best mode of practicing the appended claims and directed to one of ordinary skill in the art is set forth more particularly in the remainder of the specification. The specification makes reference to the following appended figures, in which use of like reference numerals in different features is intended to illustrate like or analogous components.

[0011] FIG. 1 is a cross-sectional diagram illustrating the parts of a known camera assembly.

[0012] FIG. 2 is a cross-sectional diagram illustrating the image sensor of the camera assembly shown in FIG. 1.

[0013] FIGS. 3A-C are diagrams illustrating exemplary lead frames that may be used to construct cameras according to certain exemplary embodiments of the present invention.

[0014] FIG. 4A is a cross-sectional side view diagram of a camera assembly assembled from the lead frame shown in FIG. 3A according to certain exemplary

embodiments of the present invention. FIG. 4B is a perspective view diagram of the assembled camera assembly shown in FIG. 4A.

[0015] FIG. 5 is a block diagram illustrating a method of constructing a camera assembly according to certain exemplary embodiments of the present invention.

[0016] FIG. 6 is a block diagram illustrating camera assembly connected to a computing device according to certain exemplary embodiments of the present invention.

DETAILED DESCRIPTION OF THE DRAWINGS

[0017] Reference will now be made in detail to various and alternative exemplary embodiments and to the accompanying drawings. Each example is provided by way of explanation, and not as a limitation. It will be apparent to those skilled in the art that modifications and variations can be made without departing from the scope or spirit of the disclosure and claims. For instance, features illustrated or described as part of one embodiment may be used in another embodiment to yield still further embodiments. Thus, it is intended that the present disclosure includes any modifications and variations as come within the scope of the appended claims and their equivalents.

[0018] In accordance with one or more embodiments of the present invention, the total number of components in a camera assembly may be reduced by providing components that serve multiple functions. FIG. 4 shows an exemplary camera assembly 30 as assembled with the lead frame 32 shown in FIG. 3A. In its most basic form the camera assembly 30 includes only three separate components—a lead frame 32, an image sensor 50, and a lens 64. The lead frame 32 itself serves several functions, and thus replaces the separate focus mechanism 6 and separate housing 8 of known systems (such as shown in FIGS. 1 and 2). Embodiments

of the invention thus reduce components and costs associated with manufacturing camera assemblies.

[0019] Several embodiments of the lead frame 32 are shown in FIGS. 3A-3C. In those figures, the lead frame 32 is unassembled and flat, and as described below, it includes sections and apertures that serve various functions and thus reduce the number components needed to construct a camera assembly. The lead frame 32 may be composed of metals, including but not limited to aluminum, copper, tin, steel, or any other suitable metal or alloy. Alternatively, the lead frame may be composed of a plastic or thermoplastic material (e.g., acrylic, Plexiglass, polycarbonate, etc.) or of any other suitable rigid or semi-rigid materials, as will be apparent to those skilled in the art. Various manufacturing processes may be used to form the shape of the lead frame 32 (and the sections and apertures contained therein), including but not limited to extruding, molding, die cutting, stamping, and/or cutting with a laser, knives, or scissors. For example and not by way of limitation, to manufacture the lead frame 32 there may be provided a blank of material, and a die may be used to cut or stamp the shape of the lead frame 32 (and the sections and apertures contained therein) out of the blank of material. The blank of material can include metals, plastics, or polymers as described above. The thickness of the blank of material is dependent upon the intended application or environment for the camera assembly 30.

[0020] The lead frame 32 is beneficial because it serves multiple functions. First, the lead frame 32 may form a housing for the camera assembly 30. The embodiments of lead frame 32 in FIGS. 3A-C each have at least four discrete sections 34, 36, 38, and 40. The at least four sections 34, 36, 38, and 40 of the unassembled lead frame 32 form four walls of the housing when the lead frame 32 is fully assembled. This disclosure may refer to "sections"

of the lead frame 32 and "walls" of the housing interchangeably. Thus, FIG. 4A and 4B show camera assembly 30 that is made from the lead frame 32 in FIG. 3A. (The embodiments of the lead frames 32 shown in FIGS. 3B and 3C may also be folded into a housing for the camera assembly 30, although they are not shown in the figures.) It should be noted that the camera assemblies 30 and lead frames 32 in the figures are not drawn to scale, and that the scale is not necessarily consistent between the figures.

[0021] The exemplary lead frame 32 in FIG. 3A has four sections 34, 36, 38, and 40, that are designed to be folded into the exemplary four-walled housing shown in FIG. 4A and 4B. In some embodiments it may be desirable to add fifth and sixth walls to substantially enclose the housing for the camera assembly 30. For example, fifth and/or sixth walls may be formed by plastic overmoldings that may be used to secure the wires 52 of the optical sensor 50 in place. Such overmouldings may be formed in a plane perpendicular to the plane of the lead frame 32, such that a portion of each overmolding forms the fifth and sixth walls when the lead frame 32 is folded into its assembled configuration. Alternatively, the overmoldings may be formed in a plane substantially parallel to the plane of the lead frame 32, with a portion of each overmolding being bent or folded into position to form the fifth and sixth walls. In other embodiments, the fifth and sixth walls may be formed using aluminum tape, adhesive, soldering, bonding, mechanical fasteners or the like. The optional fifth and sixth walls may be constructed from either the same or a different type of material as the rest of the lead frame 32. Alternatively, the assembled housing for the camera assembly 30 may be mounted on a mounting mechanism (or on other components) so that the open ends of the housing are covered by the mounting mechanism itself.

[0022] In some embodiments (not shown) the lead frame 32 may have fewer than four sections. For example, the lead frame may only have three sections so that when assembled, the lead frame forms a triangular-shaped housing for the camera assembly. In other embodiments the lead frame may have more than four sections. For example, a lead frame with eight sections might form an octagon-shaped housing for the camera.

[0023] FIGS. 3A and 3C show embodiments having a tag 42, which is optional and not required. The tag 42 may be used to secure or hold the lead frame 32 in place while it is being manufactured. When manufacturing is complete, the tag 42 may be removed from the rest of the lead frame 32 by breaking the tag 42 off along the holes 62. The tag 42 may be cut from the same blank of material as the rest of the lead frame 42, or the tag 42 may be attached to the lead frame 32 by overmolding or other known techniques.

[0024] There may be fold lines (56, 58, and 60) located between the sections that facilitate folding of the lead frame 32 to make the housing. If desired, the fold lines may be perforated, scored, or embossed to further facilitate folding of the lead frame 32. Alternatively, there may be a plurality of openings along fold lines 56, 58 such as shown in FIG. 3A that further facilitate folding. In general, however, it is desirable to construct lead frame 32 with as few holes as possible in order to limit the amount of light that is introduced into the camera assembly 30 as assembled (such as in FIG. 4). The folding may be done either manually or mechanically, such as by way of a press or other suitable machine. The folding technique is dependent upon the material of the blank, the intended application, or the environment for the camera assembly 30. Once folded, the walls of the housing may be secured in place with any known method, including but not limited to adhesive, soldering,

bonding, or mechanical fasteners. In certain embodiments, the housing is made waterproof by joining the folded edges of the lead frame 32 with appropriate adhesives and sealants.

[0025] Second, the lead frame 32 may provide a mount for the image sensor 50. The image sensor 50 may be mounted to any section of the lead frame 32. In FIG. 3A, the image sensor 50 is mounted to section 36, in FIG. 3B it is mounted to section 34, and in FIG. 3C it is mounted to section 38. The image sensor 50 may be mounted to the lead frame 32 (whatever section is selected as the location for the lead frame 32) with any known technique, including but not limited to adhesive, soldering, bonding, or mechanical fasteners (such as tacks, pins, snaps, nails, or buttons). The image sensor 50 can be based on complementary metal oxide semiconductor (CMOS), charge coupled device (CCD), or charge injection device (CID) technologies, or any other sensor technology capable of detecting changes in electromagnetic radiation. The image sensor 50 may also include a one dimensional or two dimensional array of pixels. The size and shape of the image sensor 50 and the size and shape of the housing of camera assembly 30 may be dependent upon one another. For example, if a small camera assembly 30 is desired, then it may be necessary to use smaller image sensors 50. If a larger camera assembly 30 is desired, then it may be possible to use larger image sensors 50.

[0026] A clear coating 54 may be applied over the image sensor 50 to cover and protect the image sensor 50. The coating 54 is initially liquid and may be applied or brushed onto the image sensor 50 with an applicator. The coating is a protective encapsulate that is transparent at the wavelengths at which the image sensor 50 operates. (Thus the term "clear" is used to describe any coating that is transparent at the wavelengths at which the image sensor 50 operates, and is not limited to coatings that appear to be clear to the naked eye.)

One non-limiting example of clear coating 54 is the ULTRA LIGHT-WELD 3069 series offered by the company Dymax Corporation, located in Torrington, Connecticut. The clear coating 54 is beneficial because there is no casting or separate components required, as opposed to other systems (such as shown in FIG. 2) that require casting a separate window 20 to mount over the image sensor. Thus the clear coating 54 provides more efficiencies than known components such as windows.

[0027] FIGS. 3A-C also show a plurality of wires 52 to connect the image sensor 50 directly or indirectly to a processor, *e.g.*, a digital signal processor or the processor of a general or specialized computing device. For example, the connecting wires 18 may be connected to a circuit board, a communication bus, an interface adapter or other suitable connector. Although the figures do not show the precise electrical connections that may be desired to connect the image sensor 50 to computing device 90 (as shown in FIG. 6) or other electrical components, such electrical connections would be obvious to one of skill in the art.

[0028] In addition, camera assembly 30 may include one or more optical emitters 68. Embodiments having optical emitters 68 may be useful if the camera assembly 30 is used with a touch screen. Touch screens have several applications, among them in computer displays, video monitors, or white boards, etc. Touch screens rely on the detection of light (or other forms of energy) emitted across the touch screen. In such embodiments, the camera assembly 30 may be positioned along one or more edges of the touch screen, with the field of view of the camera assembly 30 pointed towards the center of the touch screen. The optical emitter 68 emits some type of light or energy across the a touch screen. In some embodiments, optical emitter 68 may be a light emitting diode (LED) that generates infrared (IR) radiation. In other embodiments, the optical emitter 68 may generate energy in other

portions of the EM spectrum. The optical emitters 68 may generate other types of energy as applicable with appropriate image sensor 50.

[0029] Embodiments of touch screens may have reflective or retroreflective materials mounted or affixed to the edges of the touch screen. Retroreflective materials are designed to reflect the emitted light in substantially the same direction from which it originated, and reflective materials are designed to reflect the emitted light in general across the touch screen. Thus, light or energy may be emitted by optical emitter 68, reflected by the reflective (or retroreflective) materials, and received through the aperture 48 of the camera assembly 30. If an object is interrupting light in the touch screen (for example, if a finger, pen, stylus, or other object is touching the touch screen), the object will cast a shadow on the reflective material, which may be registered by the image sensor 50 of the camera assembly 30. The system may then use triangulation or other calculation techniques to determine the location of the touch object based on the location of the shadow that is registered by the image sensor 50.

[0030] As shown in FIG. 4A and 4B, the optical emitter 68 is mounted on the outer surface of the housing when the camera assembly 30 is fully assembled. (Thus, in FIG. 3A-C the optical emitter 68 is in shadow lines because the optical emitter 68 is mounted on the opposite side of the lead frame 32.) Although the figures show the optical emitter 68 as mounted on the same section as the aperture 48, it should be understood that the optical emitter 68 may be mounted on other sections as well. Additionally, the figures show two optical emitters 68, but there may be fewer than or more than two optical emitters 68 in other embodiments.

[0031] The lead frame 32 also provides an aperture 48 for the camera assembly 30. Light is introduced into the assembled camera assembly 30 through the aperture 48 and is received by the image sensor 50.

[0032] The exact placement of the aperture 48 relative to the image sensor 50 is not essential. For example, in FIG. 3A the image sensor 50 is mounted on section 36, and the aperture 48 is defined in section 40. In FIG. 3B the image sensor 50 is mounted on section 34 and the aperture 48 is defined in section 38. In FIG. 3C the image sensor 50 is mounted on section 38 and the aperture 48 is defined in section 40.

[0033] In some embodiments it may be preferred to design the lead frame 32 such that the image sensor 50 is on a wall opposite the aperture 48 when the camera assembly 30 is assembled, such as in FIG. 4. Thus, as shown in FIGS. 3A and 3B, the image sensor 50 and the aperture 48 are mounted on alternating sections. But it is not essential for the aperture 48 to be defined in a wall that is opposite the image sensor 50. In FIG. 3C for example, the aperture 48 and image sensor 50 are on adjacent sections 38, 40 such that when assembled, the aperture 48 and image sensor 50 will be on adjacent walls of the housing. Thus the particular placement and order of the sections (and aperture 48 and image sensor 50) are not essential and should not be limited to the embodiments shown in the figures.

[0034] Another function of lead frame 32 is to provide a section that serves as both a mount for a lens 64 and a way to focus the lens 64. Thus, as described in more detail below, the embodiments in FIGS. 3A and 3B provide two focus sections 44, 46 whereas FIG. 3C only shows one focus section 44. In the embodiments shown in the figures, the focus sections 44, 46 have a square or rectangular shaped body defined by a cut-out in the lead frame 32, but that shape is not limiting. Rather, the focus sections 44, 46 can be any shape

suitable for mounting the lens 64, such as circular, triangular, hexagon, or any other shape. Two bars 66 connect the focus section 44, 46 to the rest of the lead frame 32. The particular design of the bars 66 is not essential, and in some embodiments, there may be only one bar. The bars 66 enable the focus sections 44, 46 to be moved in position with respect to the rest of the lead frame 32 (and in particular, moved with respect to the image sensor 50 when the camera assembly 30 is fully assembled as in FIGS. 4A and 4B). Specifically, when a force is applied to the focus sections 44, 46, the bars 66 deform slightly in the direction of the force. Thus the focus sections 44, 46 are "bent" into the desired position. The focus sections 44, 46 may be bent into position in the direction of the arrows shown in FIGS. 3A-C within the space that surrounds the body of the focus sections 44, 46. It may also be desirable in some embodiments to bend the focus sections 44, 46 either into or out of the plane of the lead frame 32.

[0035] The focus sections 44, 46 serve as a mount for the lens 64. The lens 64 may be a single element aspherical lens, with an f-theta characteristic, which can be constructed from transparent plastic material or glass. The single element lens results in reduced internal reflections without resorting to anti reflection coatings and improved accuracy and mechanical stability compared to known multi-element glass lens solutions. The f-theta lens characteristic is desirable in optical position sensing, as it results in a basically linear correspondence between pixel number and angle of refraction. The lens 64 need not be a single element aspherical lens, however, but may be include any lens known to those of skill in the art. Mounting of the lens 64 to the focus sections 44, 46 may be accomplished with any one of known techniques, including but not limited to adhesive, soldering, bonding, or mechanical fasteners.

[0036] Once the lens 64 is mounted to the focus sections 44, 46, the lens 64 may be focused by positioning the focus sections 44, 46 (together with the lens 64) either closer to or further away from the image sensor 50. Adjusting the position of the lens 64 changes the convergence point of the light refracted through the lens 64 onto the image sensor 50, thus changing the relative focus of lens 64. Once the desired focus is reached, the lens 64 may be fixed in the desired position. Fixing the lens 64 in the desired position may be accomplished with any one of known techniques, including but not limited to the use of adhesive, soldering, bonding, or mechanical fasteners.

[0037] In FIG. 3A there are two focus sections 44, 46 that are on either side of section 36, upon which the image sensor 50 is mounted. Thus when the lead frame 32 is folded into a housing for the camera assembly 30, focus section 44 will be on one wall adjacent to the image sensor 50, and focus section 46 will be on the other wall that is adjacent to the image sensor 50. In FIG. 3B the image sensor 50 is mounted to section 34, and the focus sections 44, 46 are on sections 36 and 40, respectively. When the lead frame 32 is folded into a housing, section 40 will be adjacent to section 34. Thus, as in FIG. 3A, when assembled focus section 44 will be on one wall adjacent to the image sensor 50, and focus section 46 will be on the other wall that is adjacent to the image sensor 50. On the other hand, in FIG. 3C, there is only one focus section 44. When the lead frame 32 in FIG. 3C is folded, the focus section 44 will be on a wall that is adjacent to the image sensor 50, and there are no other focus sections. The respective positioning of the focus sections 44, 46 and image sensor 50 are not limiting. Thus, as an alternative to FIG. 3C, focus section 44 may be located on section 34 such that when assembled, focus section 44 would be opposite to the image sensor 50.

[0038] In certain embodiments, it may be desirable to overmold the lead frame 32 to make further housing or attachment fixtures. For example, assembly tags, mounting pins, or features to locate and secure the image sensor 50 may be overmolded onto the lead frame 32. The optional tag 42, which may be used to hold the lead frame 32 in place while it is being manufactured, is another example of a component that may be over molded. Still another example is an optional fifth or sixth section of the lead frame 32 that form the fifth and sixth walls of the housing for the camera assembly 30. Finally, components that are used to hold and isolate electrical components of the image sensor 50 may be overmolded

[0039] FIG. 5 shows a method for constructing a camera assembly 30 according to certain embodiments. Step 72 comprises preparing the lead frame 32, which includes providing a blank of material (such as metal, polymer, or a plastic) and then forming the blank of material into the desired shape of the lead frame 32. The lead frame 32 may be formed by a die, stamp, laser, knives, scissors, or can be molded or extruded. Step 72 also includes forming the aperture 48, focus sections 44, 46, and any sections, holes, or fold lines in the lead frame 32.

[0040] Step 74 comprises mounting the image sensor 50 to the lead frame 32. The image sensor 50 may be mounted to any section of the lead frame 32, as described above with respect to FIGS. 3A-C, and may be mounted with any known technique, including but not limited to the use of adhesive, soldering, bonding, or mechanical fasteners (such as tacks, pins, snaps, nails, or buttons). Step 74 also includes the optional step of applying a clear coating 54 over the image sensor 50 to cover and protect the image sensor 50, and affixing any necessary connecting wires 52.

[0041] Next, step 76 comprises folding the sections of the lead frame 32 to make the housing of the camera assembly 30. As described, there may be fold lines (56, 58, and 60) located between the sections that facilitate folding of the lead frame 32. Step 76 may also include the step of securing the lead frame 32 in the folded position, such as by using adhesive, soldering, bonding, or mechanical fasteners.

[0042] Step 78 comprises mounting the lens 64 to the focus sections 44, 46 of the lead frame 32. The lens 64 may be mounted to the focus sections 44, 46 using any one of known techniques, including but not limited to the use of adhesive, soldering, bonding, or mechanical fasteners.

[0043] Finally, step 80 comprises focus the lens 64 by moving the lens 64 either closer to or further away from the image sensor 50 by translating the focus sections 44, 46. Once the desired focus is reached, the lens 64 may be fixed in the desired position using any one of known techniques, including but not limited to the use of adhesive, soldering, bonding, or mechanical fasteners.

[0044] In an optional step, side walls may be added to completely enclose the housing for the camera assembly 30. For example, if desired side walls may be constructed from the same type of material as the rest of the lead frame 32, and may be mounted to the housing using any known technique.

[0045] FIG. 6 is a block diagram illustrating a camera assembly 30 interfaced with a computing device 90 in accordance with exemplary embodiments of the invention. Computing device 90 may be coupled to the camera assembly 30 by hardwire (e.g., the connecting wires 52) and/or wireless connections. Computing device 90 may be any suitable computing device, including, but not limited to a processor-driven device such as a personal

computer, a laptop computer, a handheld computer, a personal digital assistant (PDA), a digital and/or cellular telephone, a pager, a video game device, etc. These and other types of processor-driven devices will be apparent to those of skill in the art. As used in this discussion, the term "processor" can refer to any type of programmable logic device, including a microprocessor or any other type of similar device. Computing device 90 may include, for example, a processor 92, a system memory 94, and various system interface components 96 that may all be functionally connected via a system bus 100.

[0046] The system interface components 96 may enable the processor 92 to communicate with peripheral devices. For example, a storage device interface 102 can provide an interface between the processor 92 and a storage device 108 (removable and/or non-removable), such as a disk drive. A network interface 104 may also be provided as an interface between the processor 92 and a network communications device (not shown), so that the computing device 90 can be connected to a network. An input/output (I/O) interface 106 can provide an interface between the processor 92 and the camera assembly 30. For example, the image sensor 50 may provide input signals (such as those representing images taken by the image sensor 50) to the processor 92 via interface 106. Similarly, the image sensor 50 may receive output signals from the processor 92 via the interface 106.

[0047] A number of program modules may be stored in the system memory 94. (Program modules may also be stored in any other computer-readable media associated with the storage device 108 (e.g., a hard disk drive), and/or any other data source accessible by computing device 90.) The program modules may include an operating system 110 that may control the processor 92. Also, program modules may include those for controlling a touch screen. One or more camera assemblies 30 can be mounted to a display (such as LDC,

plasma, CRT, or static image) that is also interfaced with the computing device 90 to produce a touch screen system.

[0048] The various systems discussed herein are not limited to any particular hardware architecture or configuration. As was noted above, a computing device can include any suitable arrangement of components that provide a result conditioned on one or more inputs. Suitable computing devices include multipurpose microprocessor-based computer systems accessing stored software, but also application-specific integrated circuits and other programmable logic, and combinations thereof. Any suitable programming, scripting, or other type of language or combinations of languages may be used to implement the teachings contained herein in software.

[0049] In some embodiments, the methods of manufacturing disclosed herein may be embodies as software methods for controlling manufacturing equipment. The software methods may access one or more computer-readable media that embody computer-readable instructions which, when executed by at least one computer, cause the at least one computer to implement instructions to control manufacturing equipment. When software is utilized, the software may comprise one or more components, processes, and/or applications. The manufacturing equipment may be any equipment described herein, such as robotic die cutters, stampers, solder tools, or folders. Any suitable computer-readable medium or media may be used to implement or practice the presently-disclosed subject matter, including, but not limited to, diskettes, drives, magnetic-based storage media, optical storage media, including disks (including CD-ROMS, DVD-ROMS, and variants thereof), flash, RAM, ROM, and other memory devices, and the like.

[0050] While the present subject matter has been described in detail with respect to specific embodiments thereof, it will be appreciated that those skilled in the art, upon attaining an understanding of the foregoing may readily produce alterations to, variations of, and equivalents to such embodiments. Accordingly, it should be understood that the present disclosure has been presented for purposes of example rather than limitation, and does not preclude inclusion of such modifications, variations and/or additions to the present subject matter as would be readily apparent to one of ordinary skill in the art.

CLAIMS

1. A camera assembly comprising:

a body having at least three walls integrally formed from a single blank of material;

an aperture defined in a first wall of the body for allowing light to enter into the body;

an image sensor mounted on an inner surface of a second wall of the body, wherein the image sensor receives the light that enters the body through the aperture; and

a lens mounted on a first focus section formed on at least a portion of a third wall of the body, wherein the first focus section translates in at least one direction relative to the second wall, thereby allowing the focus of the lens relative to the image sensor to be changed.

2. The camera assembly as in claim 1, wherein the body is made of a material comprising at least one of aluminum, copper, tin, steel, plastic, thermoplastic material including acrylic, Plexiglass, or polycarbonate.

3. The camera assembly as in claim 1, wherein the first focus section comprises a body and at least one bar that connects the body to the third wall, and the first focus section translates by applying a force to the body to thereby deform the bar.

4. The camera assembly as in claim 1, further comprising a clear coating that covers the image sensor.

5. The camera assembly as in claim 1, wherein the body has at least four walls integrally formed from a single blank of material.

6. The camera assembly as in claim 5, further comprising a second focus section formed on at least a portion of a fourth wall of the body, wherein the second focus section translates in at least one direction relative to the second wall.

7. The camera assembly as in claim 6, wherein the lens is mounted on both the first and second focus sections, and wherein both the first and second focus sections translate in at least one direction relative to the second wall, thereby allowing the focus of the lens relative to the image sensor to be changed.

8. The camera assembly as in claim 5, wherein the first wall is opposite to the second wall, and the third wall is opposite to the fourth wall.

9. The camera assembly as in claim 1, further comprising at least one optical emitter mounted on the outer surface of at least one wall of the body.

10. A method for manufacturing a camera assembly, the method comprising:

providing a blank of material;

defining a lead frame from the blank of material, the lead frame having at least three integrally formed sections, wherein at least a portion of a first section defines an aperture,

and at least a portion of the second section defines a mounting surface, and at least a portion of the third section defines a first focus section;

folding the sections of the lead frame to thereby define a body of the camera, wherein the aperture allows light to enter the body;

mounting an image sensor on the mounting surface, wherein the image sensor receives the light that enters the body through the aperture;

mounting a lens to the first focus section; and

translating the first focus section in at least one direction relative to the mounting surface, thereby allowing the focus of the lens relative to the image sensor to be changed.

11. The method as in claim 10, wherein defining the lead frame comprises at least one of extruding, molding, die cutting, stamping, or cutting the lead frame from the blank of material.

12. The method as in claim 10, wherein mounting the image sensor to the mounting surface comprises using at least one of adhesive, soldering, bonding, or mechanical fasteners including tacks, pins, snaps, nails, or buttons.

13. The method as in claim 10, wherein mounting the lens to the first focus section comprises using at least one of adhesive, soldering, bonding, or mechanical fasteners including tacks, pins, snaps, nails, or buttons.

14. The method as in claim 10, wherein folding the sections of the lead frame comprises at least one of manual folding or mechanical folding.

15. The method as in claim 10, further comprising securing the folded sections of the lead frame in place.

16. The method as in claim 10, further comprising waterproofing the folded sections of the lead frame with adhesives or sealants.

17. The method as in claim 10, further comprising securing the lens and the focus section in place after the lens is focused.

18. The method as in claim 10, wherein the first focus section comprises a body and at least one bar that connects the body to the third wall, and translating the first focus section comprises applying a force to the body to thereby deform the bar.

19. The method as in claim 10, further comprising overmolding a fourth and fifth section to the lead frame to thereby define an enclosed body of the camera.

20. The method as in claim 20, further comprising overmolding a tag to the lead frame, wherein the tag secures the lead frame during at least a portion of the method for manufacturing a camera assembly.

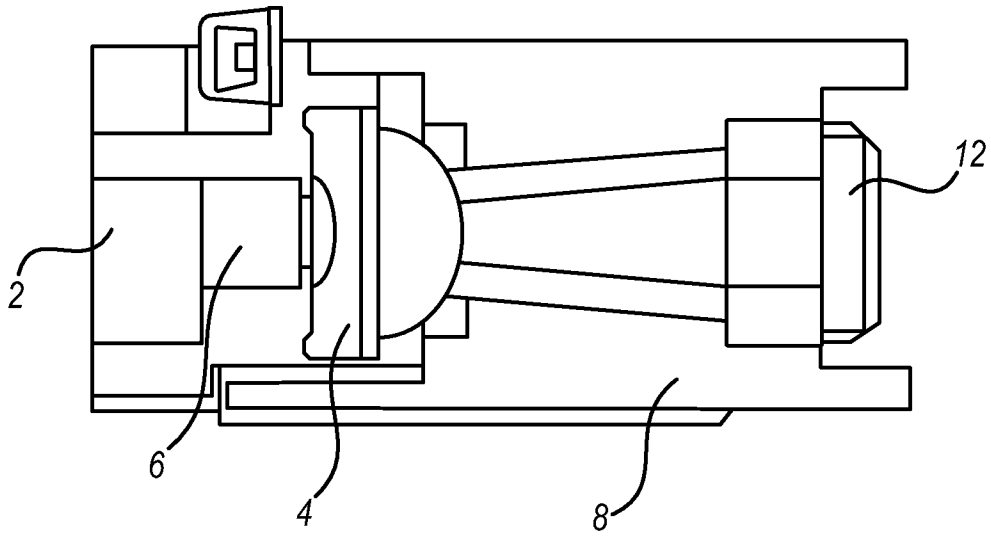

FIG. 1
PRIOR ART

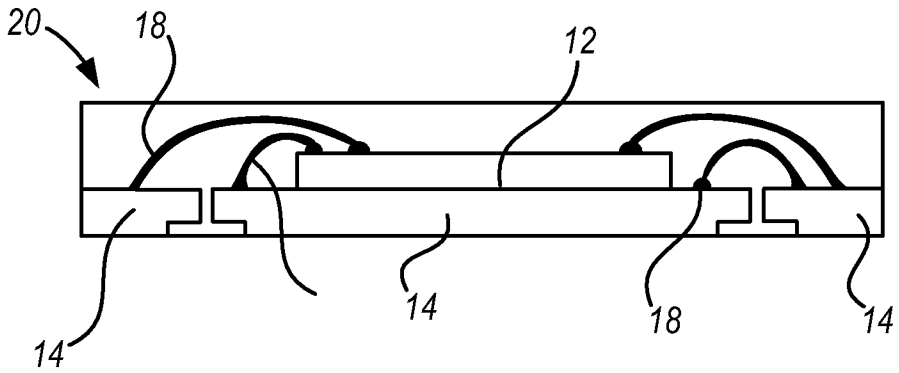

FIG. 2
PRIOR ART

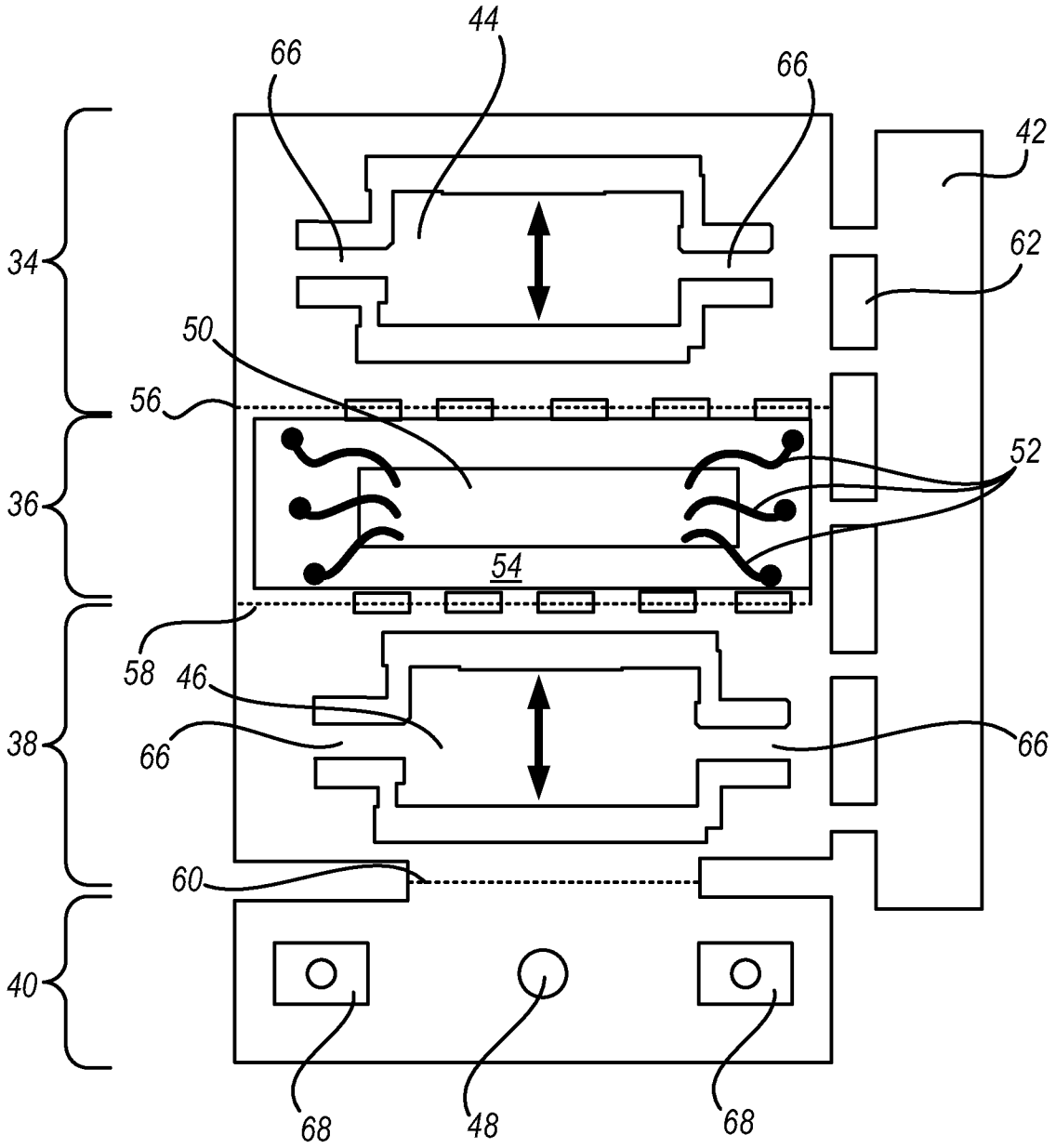

FIG. 3A

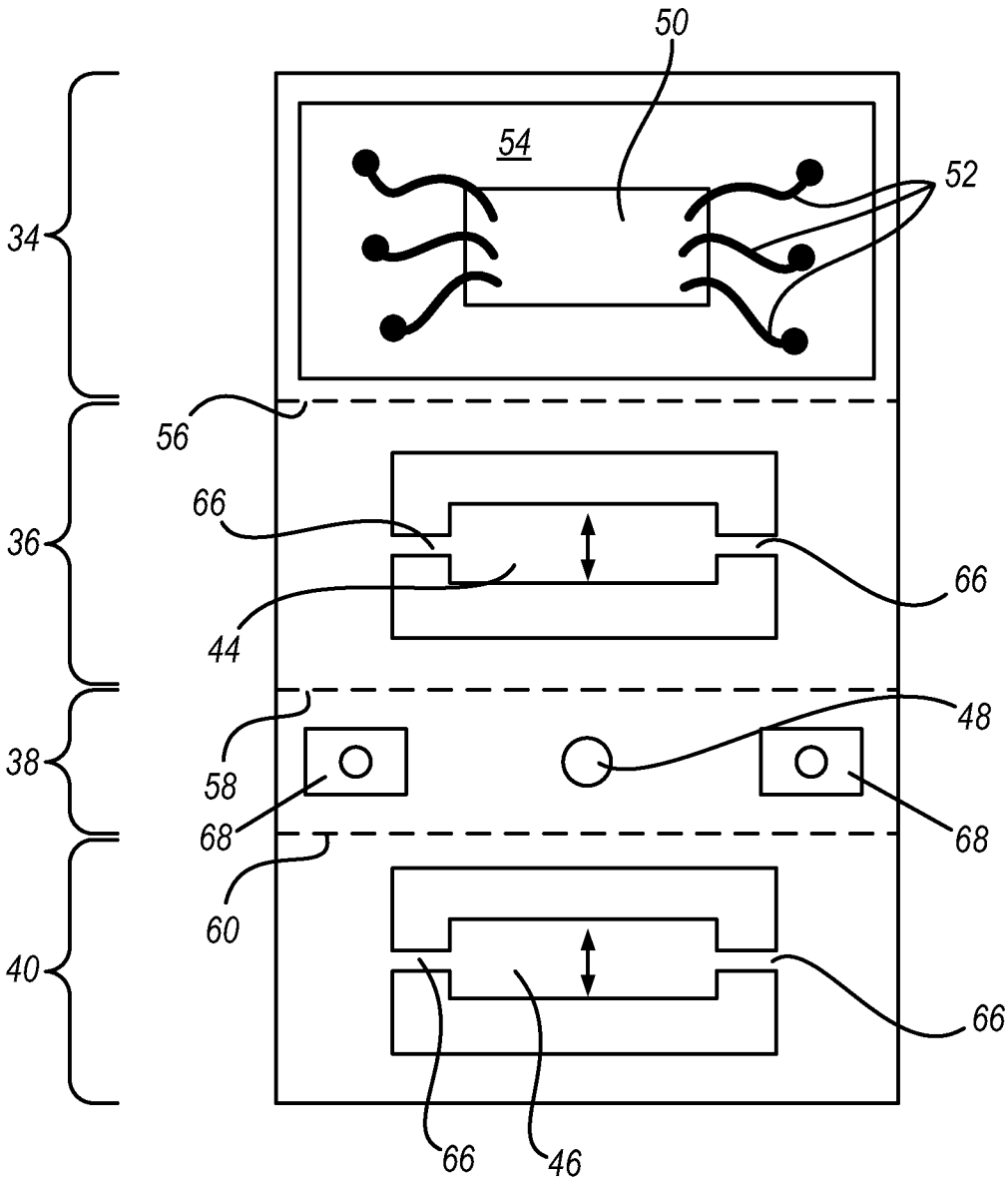

FIG. 3B

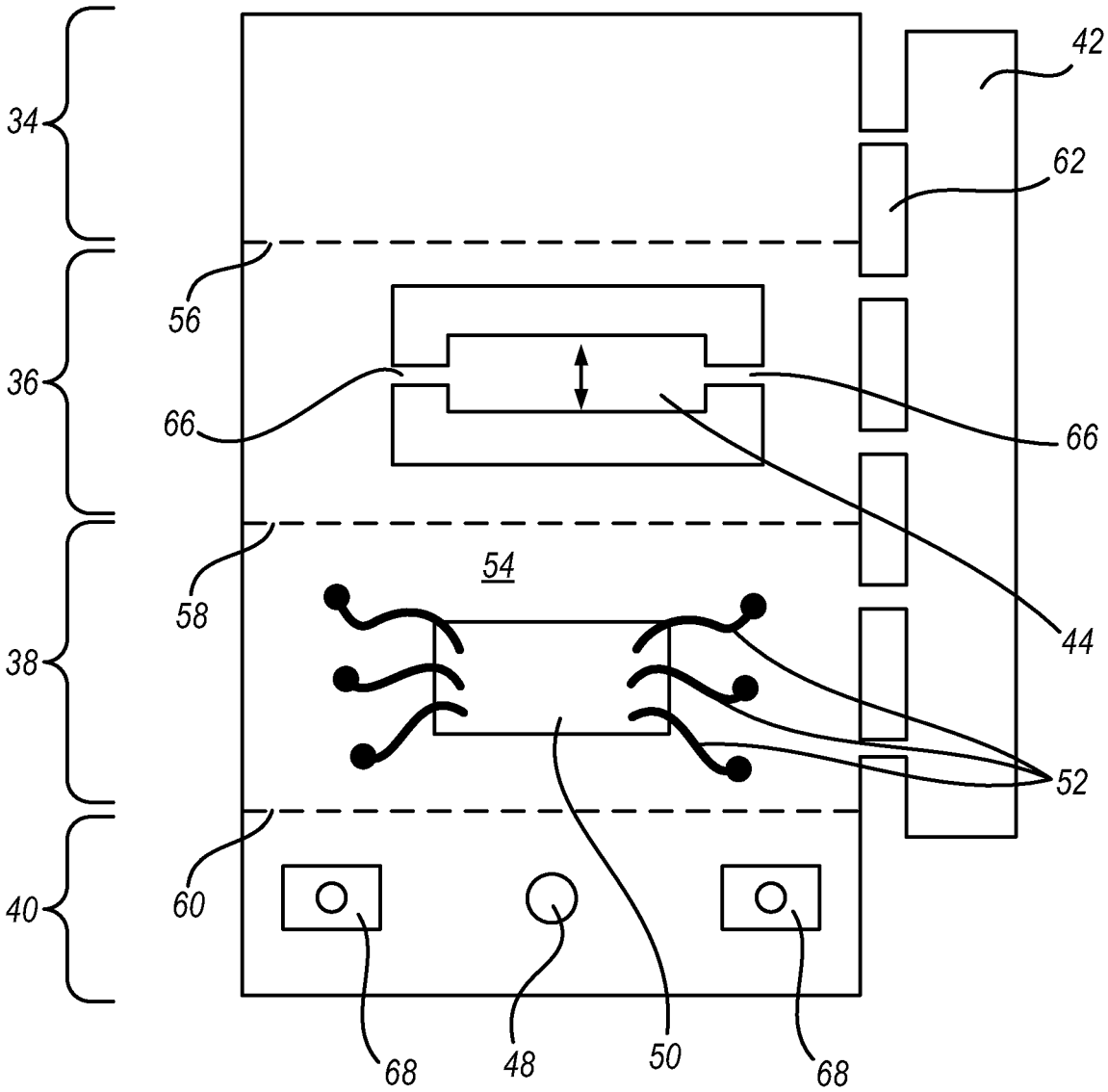

FIG. 3C

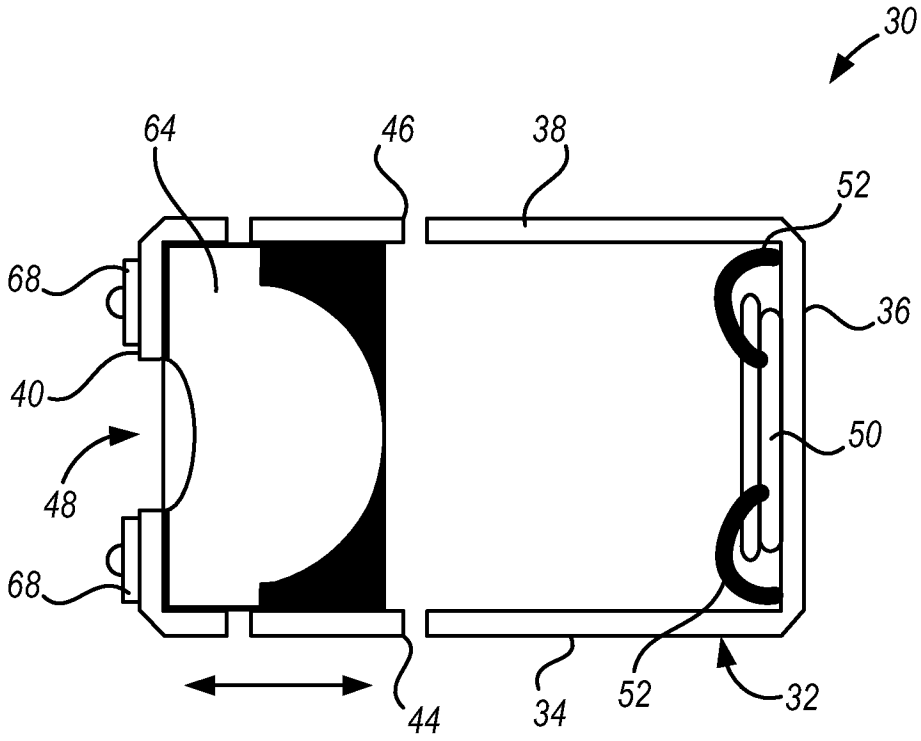

FIG. 4A

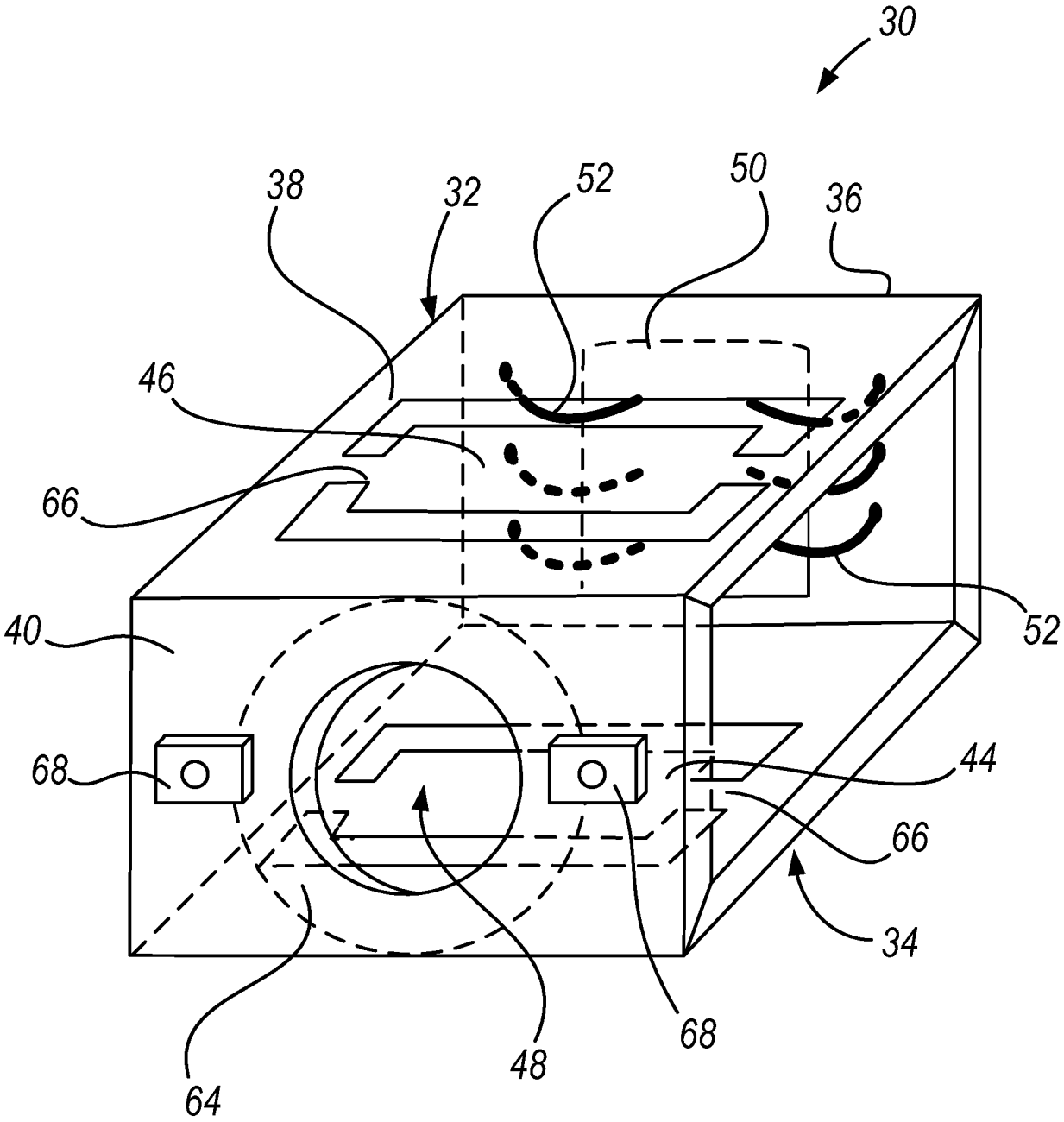

FIG. 4B

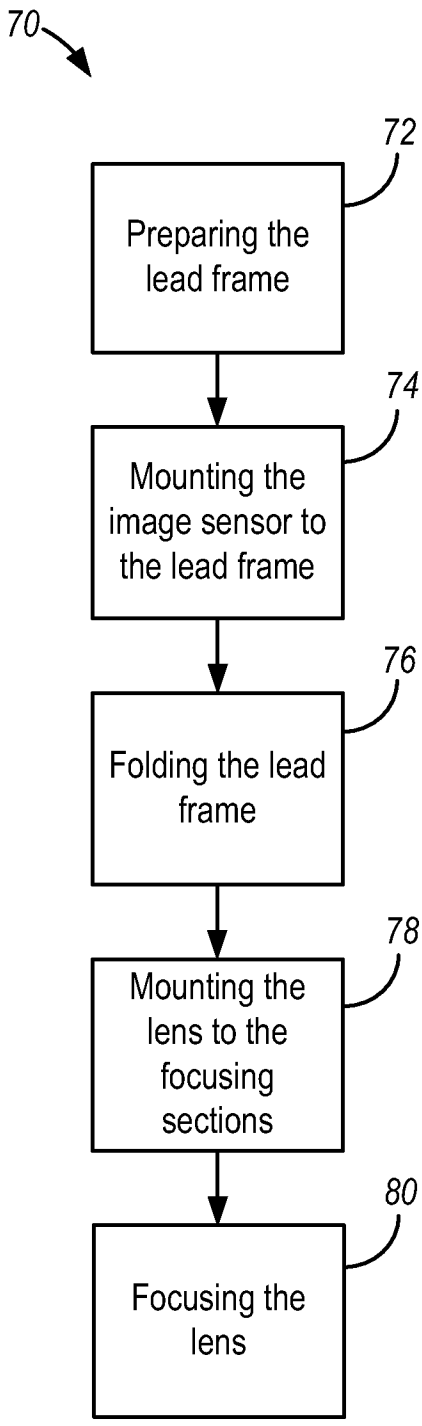
70
72
Preparing the lead frame
74
Mounting the image sensor to the lead frame
76
Folding the lead frame
78
Mounting the lens to the focusing sections
80
Focusing the lens

FIG. 5

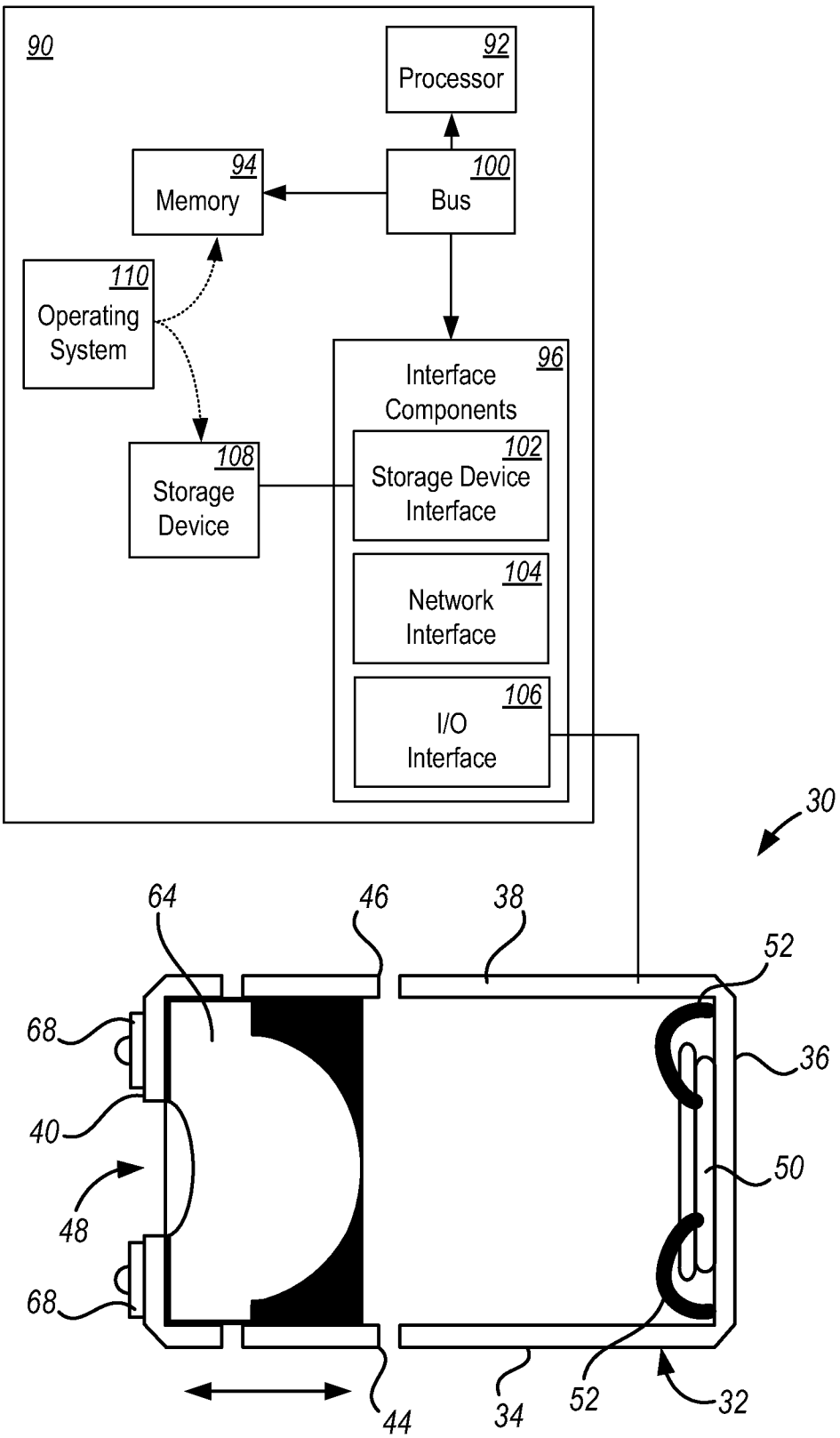
90
92
Processor
94
Memory
100
Bus
110
Operating System
96
Interface Components
102
Storage Device Interface
108
Storage Device
104
Network Interface
106
I/O Interface
30
64
46
38
52
68
36
40
50
48
68
44
34
52
32

FIG. 6

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2009/059193

A. CLASSIFICATION OF SUBJECT MATTER
INV. G03B17/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G03B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, COMPENDEX, EMBASE, FSTA, INSPEC, IBM-TDB, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 043 751 A (RICE) 27 August 1991 (1991-08-27) folding cameras; column 6, line 67 - page 16, line 2; figures 1-29	1-20
A	US 4 329 037 A (CAVINESS) 11 May 1982 (1982-05-11) folding camera comprising a unitary blank of material; column 1, line 64 - column 3, line 10; figures 1-12	1-20
A	US 5 103 249 A (KEENE) 7 April 1992 (1992-04-07) folding camera comprising a unitary blank of material; column 3, line 63 - column 5, line 17; figures 1-10	1-20

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 November 2009	07/12/2009

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Tomezzoli, Giancarlo

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2009/059193

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 844 152 A (LITTLE) 12 February 1907 (1907-02-12) folding camera; page 1, line 26 - page 2, line 3; figures 1-4	1-20
A	EP 0 843 202 A1 (GLOVER ET AL) 20 May 1998 (1998-05-20) folding camera; column 3, line 54 - column 5, line 54; figures 1-5	1-20

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2009/059193

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5043751 A	27-08-1991	NONE	
US 4329037 A	11-05-1982	NONE	
US 5103249 A	07-04-1992	AU 8918991 A	26-05-1992
		CA 2072067 A1	25-04-1992
		DE 69113440 D1	02-11-1995
		DE 69113440 T2	07-03-1996
		EP 0506940 A1	07-10-1992
		JP 5503374 T	03-06-1993
		WO 9208163 A1	14-05-1992
US 844152 A		NONE	
EP 0843202 A1	20-05-1998	DE 69720372 D1	08-05-2003
		DE 69720372 T2	18-12-2003
		JP 10301179 A	13-11-1998
		US 5933659 A	03-08-1999