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(54) Title: SCAN UNIT FOR A SCANNING MODULE

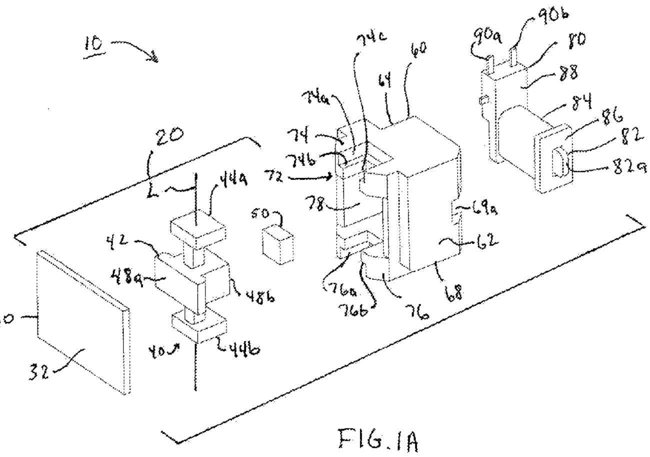

FIG. 1A

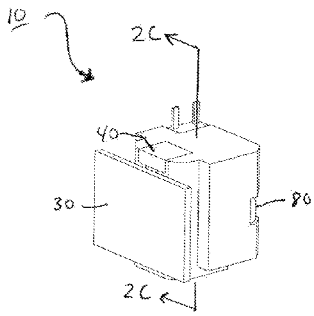

FIG. 1B

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(57) **Abstract**: A scan unit for a scanning module includes a holder; a flexural member; a light scanning mirror attached to the flexural member; a magnet attached to the flexural member; and a drive coil for oscillating or vibrating the magnet, thereby oscillating or vibrating the light scanning mirror. Further, a method for making a scan unit includes inline assembling a light scanning assembly, a drive coil and a holder to one another.

SCAN UNIT FOR A SCANNING MODULE

FIELD

The present disclosure relates to devices for optically scanning images. More particularly, the present disclosure relates to a scan unit for a scanning module.

BACKGROUND

A barcode is an optical machine-readable label attached to an object, which directly or indirectly represents information about the object. Such information can include, without limitation, vendor identification, product name, price, patient name and other descriptive information about the object. Barcode reading devices are widely used in distribution, retail and many other industries for reading barcodes.

One common type of barcode reading device includes a barcode scanning module that a produces a laser light beam generated by a light source, such as laser diode. The barcode scanning module further includes a rotating or vibrating mirror arrangement that scans the light beam across the barcode. Light reflected by the barcode is condensed and received by a light receiving sensor of the module and is converted into an electrical signal representing the barcode. The electrical signal representing the barcode is decoded, and outputted as bar code read information.

The current trend is to reduce the size and weight of the barcode reading device to make it easier to use and less expensive to manufacture. This, in turn, requires the use of a dimensionally more compact light scanning module.

Accordingly, a scan unit is needed, which is inexpensive and easy to assemble and takes up less space in a light scanning module.

SUMMARY

Disclosed herein is a scan unit for a scanning module. In one embodiment, the scan unit comprises a holder; a mirror movable relative to the holder, the mirror for scanning light onto an object; a magnet movable relative to the mirror and disposed at least partially within the holder, the magnet for moving the mirror; and a drive coil disposed at least partially within the holder for moving the magnet.

In another embodiment, the scan unit comprises an annular-shaped holder; a flexural member disposed across a first side of the holder; a mirror attached to a first side of the flexural member, the mirror for scanning light onto an object; a magnet attached to a second side of the flexural member; and a drive coil attached to a second side of the holder, the drive coil for oscillating or vibrating the magnet.

Further disclosed herein is a method for making a scan unit. In one embodiment, the method comprises providing a holder; providing a light scanning assembly; inline assembling one of the light scanning assembly and the drive coil to the holder; and inline assembling the holder to the other one of the light scanning assembly and the drive coil.

In another embodiment, the method comprises providing a holder; providing a light scanning assembly; and inline assembling the light scanning assembly and the drive coil to the holder.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A is an exploded perspective view of a scan unit according an exemplary embodiment of the present disclosure.

FIG. 1B is an assembled perspective view of the scan unit of FIG. 1A.

FIG. 2A is a front elevational view of a holder according to an exemplary embodiment of the present disclosure.

FIG. 2B is a rear elevational view the holder shown in FIG. 2A.

FIG. 2C is a sectional side view of the scan unit through line 2C-2C of FIG. 1B.

FIG. 3A is a perspective view of a holder according to another exemplary embodiment of the present disclosure.

FIG. 3B is a section side view of the scan unit comprising the holder shown in FIG. 3A.

FIGS. 4A-4C are perspective views illustrating different methods for inline assembling the components of the scan unit.

FIG. 5 is a perspective view of a scanning module according to an exemplary embodiment of the present disclosure.

DETAILED DESCRIPTION

FIGS. 1A and 1B respectively show exploded and assembled perspective views of a scan unit 10 according an exemplary embodiment of the present disclosure. The scan unit 10 may comprise a light scanning assembly 20 for directing a light beam in a scanning pattern, an electromagnetic drive coil 80 for producing a magnetic field that drives the light scanning assembly 20 in a controlled manner, and a holder 60 for integrating the light scanning assembly 20 and drive coil 80 together as a single unit.

As shown in FIG. 1A, the electromagnetic drive coil 80 may comprise an elongated core 82, an electrical conductor 84 wound around the core (coil), a first flange 86 disposed at a first end of the coil 84 and a second flange 88 disposed at a second end of the coil 84. The second flange may be constructed to include taps 90a, 90b for coupling the coil 84 to a drive signal source. The first end of the core 82 may extend beyond the first flange 86 and define a mounting ear 82a. In an alternate embodiment, the first end of the core 82 may extend beyond both the first and second flanges, 86 and 88 respectively, and define first and second mounting ears (not shown). The core 82, which extends through a hollow of the coil 84, may be made of a soft iron/ferromagnetic material. Therefore, the core 82 may be operative as a yoke.

Still referring to FIG. 1A, the light scanning assembly 20 may include a light scanning mirror 30, a flexural member 40, and a permanent magnet 50. The light scanning mirror 30 may comprise a planar reflecting surface 32, and can be made of metal, resin or glass. The flexural member 40 may be configured as a torsion spring 42 having a longitudinal axis L. The torsion spring 42 may comprise an inline arrangement which may include a first head member 44a, a first torsion spring element 46a, a mounting member 48, a second torsion spring element 46b, and a second head member 44b. The first head member 44a may be disposed at a first end of the first spring element 46a, and the second head member 44b may be disposed at a first end of the second spring element 46b. The mounting member 48 may have a block-like shape and be disposed between the second ends of the first and second torsion spring elements 46a, 46b. The mounting member 48 may include a first mounting surface 48a and a second mounting surface 48b disposed generally opposite the first mounting surface 48a. The first and second mounting surfaces 48a, 48b may each be disposed parallel to the longitudinal axis L. The first mounting surface 48a may be configured for fixedly attaching the light scanning mirror 30 to the torsion spring 42, and the second mounting surface 48b may be configured for fixedly attaching the magnet 50 to the torsion spring 42 so that it may be disposed generally opposite to the light scanning mirror 30.

The torsion spring elements 46a, 46b of the torsion spring 42 may have any suitable cross-sectional shape including, but not limited to, a square, a rectangle, a circle, and an oval.

The flexural member 40 (e.g., torsion spring 42) may be formed as a single unitary member and can be made of an elastomeric material, such as silicone rubber, or any other suitable material with elastomeric elastomeric properties that allows oscillation or vibrational movement of the light scanning assembly 20.

Referring to FIG. 1A, the holder 60 may comprise a first side wall 62, a second side wall 64, a first end wall 66 connecting the side walls 62, 64 at a first end of the holder 60 and a second end wall 68 connecting the side walls 62, 64 at a second end of the holder 60. The walls 62, 64, 66, 68 of the holder 60 may define an annularly enclosed interior space 70 (FIG. 2C). A cage structure 72 may be provided on a front or mirror side of the holder 60 for fixedly attaching the light scanning assembly 20 to the holder 60.

As shown in FIGS. 2A and 2C, the cage structure 72 of the holder 60 may have a first support member 74 extending out from the first end wall 66 of the holder 60 and a second support member 76 extending out from the second end wall 68. The first support member 74 may define a first receptacle 74a for fixedly receiving the first head member 44a of the torsion spring 42, and the second support member 76 may define a second receptacle 76a for fixedly receiving the second head member 44b of the torsion spring 42. The floor 74b of the first receptacle 74a may include a first slot 74c for allowing the first torsion spring element 46a to extend through the floor 74b of the first receptacle 74a when the first head member 44a of the torsion spring 42 is disposed in the first receptacle 74a. Similarly, the floor 76b of the second receptacle 76b may include a second slot 76c for allowing the second torsion spring element 46b to extend through the floor 76b of the second receptacle 76a when the second head member 44b of the torsion spring 42 is disposed in the second receptacle 76a.

As shown in FIG. 2C, when the light scanning assembly 20 is fixedly attached to the cage structure 72 of the holder 60, the mounting member 48 of the torsion spring 42 may be generally disposed within an interior space 78 defined by the cage 72 and the magnet 50 may be generally disposed within the interior space 70 defined by the holder 60.

FIG. 3A shows an alternate embodiment of the holder denoted by reference numeral 100. The holder 100 may include first and second pairs of bracket-like elements, 102 and 104 respectively, for attaching the light scanning assembly 20 to the holder 100, instead of a cage structure. The first pair of bracket elements 102 may extend from the front side of the first end wall 66 and define a first receptacle 102a for receiving the first torsion spring element 46a of the torsion spring 42. Similarly, the second pair of bracket elements 104 may extend from the front side of the second end wall 68 and define a second receptacle 104a for receiving the second torsion spring element 46b of the torsion spring 42. Further , the first pair bracket elements 102 define outwardly facing support surfaces 102b for supporting the first head member 44a of the torsion spring 42 and the second pair of bracket elements 104 define outwardly facing support surfaces 104b for supporting the second head member 44b of the torsion spring 42.

As shown in FIG. 3B, when the light scanning assembly 20 is fixedly attached to the first and second pairs of bracket elements 102 and 104, respectively, of the holder 100, the mounting member 48 of the torsion spring 42 may be generally disposed in front of the interior space 70 defined by the holder 100 and the magnet 50 may be generally disposed within the interior space 70 defined by the holder 70.

Referring to FIG. 2B, first and second recesses 69a and 69b, respectively, may be provided on a rear or coil side of the holder 60, 100 for fixedly attaching the drive coil 80 to the holder 60, 100. The first recess 69a may be formed in a rear edge surface of the first side wall 62 and the second recess 69b may be formed in a rear edge surface of the second side wall 64. The first recess 69a may be sized to receive the mounting ear 82a of the drive coil 80 and the second recess 69b may be sized to receive the second flange 88 of the drive coil 80 (which is constructed to include the taps 90a, 90b). In an alternate embodiment, the second recess 69b may be sized to receive a second mounting ear of the drive coil 80. When attached to the holder 60, 100, the drive coil 80 may be substantially disposed within the interior space 70 defined by the holder 60 immediately adjacent to but spaced from the permanent magnet 50 (FIGS. 2C and 3B).

The holder 60, 100 can be formed as a single unitary member and can be made of rubber, plastic, metallic, or any other suitable material. In some embodiments, the side walls 62 and 64 of the holder 60, 100 may be made of a ferromagnetic material and the end walls 66 and 68 be made of a plastic material. This allows the holder 60, 100 of the present disclosure to operate as a yoke to increase the driving efficiency of the drive coil 80. Although less preferred, in other embodiments, the entire holder 60, 100 may be made of a ferromagnetic material such that the holder 60, 100 may operate as a yoke.

The holder 60, 100 of the present disclosure allows the light scanning assembly 20 and the drive coil 80 to be assembled together in an inline manner. In one exemplary embodiment, as shown in FIG. 4A, the light scanning assembly 20 may be assembled by fixedly attaching the light scanning mirror 30 and the permanent magnet 50 to the first and second mounting surfaces, 48a and 48b respectively, of mounting member 48 of the torsion spring 42 (flexural member 40) to complete the light scanning assembly 20. The completed light scanning assembly 20 may then be assembled to the holder (only holder 60 is shown in FIG. 4A, but the same method can be used with holder 100) and the holder 60 with the light scanning assembly 20 may be assembled to the drive coil 80.

In an alternate embodiment, as shown in FIG. 4B, the light scanning assembly 20 may be assembled as described above by fixedly attaching the light scanning mirror 30 and the permanent magnet 50 to the first and second mounting surfaces, 48a and 48b respectively, of mounting member 48 of the torsion spring 42 (flexural member 40) to complete the light scanning assembly 20. Then, the drive coil 80 may be assembled to the holder (only holder 60 is shown in FIG. 4B, but the same method can be used with holder 100) and the holder 60 with the drive coil 80 may be assembled to the light scanning assembly 20.

In still another embodiment, as shown in FIG. 4C, the light scanning assembly 20 may be assembled as described above by fixedly attaching the light scanning mirror 30 and the permanent magnet 50 to the first and second mounting surfaces, 48a and 48b respectively, of mounting member 48 of the torsion spring 42 (flexural member 40) to complete the light scanning assembly 20. The completed light scanning assembly 20 and the drive coil 80 may then be concurrently or sequentially assembled to the holder (only holder 60 is shown in FIG. 4C, but the same method can be used with holder 100).

An adhesive may be used for fixedly attaching the light scanning mirror 30 and the permanent magnet 50 to the first and second mounting surfaces 48a and 48b, respectively, of the mounting member 48. An adhesive may be used for fixedly attaching the head members 44a, 44b of the torsion spring 42 to the receptacles 74a, 74b or bracket elements 102, 104 of the holder 60, 100. An adhesive may be used for fixedly attaching the mounting ears 82a, 82b of the drive coil 80 to the recesses 69a, 69b of the holder 60, 100.

FIG. 5 is a top view of an exemplary embodiment of a scanning module 200 comprising the scan unit 10 of the present disclosure. The scanning module 200 may be used, for example, in a barcode reading device. The scanning module 200 may comprise a housing 202, the scan unit 10 of the present disclosure, a light receiving assembly 204, a light source 206 and a controller or processor 208. A front wall 202a of the housing 202 may include an opening or window 202b for emitting and receiving light.

During operation, the processor 208 may apply or cause a drive signal to be applied to the drive coil 80. In response, the drive coil 80 may produce an electromagnetic field that oscillates or vibrates the permanent magnet 50 of the light scanning assembly 20. The oscillating or vibrating magnet 50 causes the flexural member 40/torsion spring 42 to oscillate or vibrate at the frequency of the drive signal thereby oscillating or vibrating the light scanning mirror 30. The oscillating or vibrating light scanning mirror 30 will reflect a light beam generated by the light source 206 across an object (e.g., bar code) in a desired scan pattern. Light reflected by the object may be collected by the scan unit 10 or by a separately provided light collecting mirror (not shown) and reflected onto an active area of the light receiving assembly 204. Light data may be obtained from the light receiving assembly 204 and processed by the processor 208 of the scanning module 200 to identify the object.

While exemplary drawings and specific embodiments of the present disclosure have been described and illustrated, it is to be understood that that the scope of the invention as set forth in the claims is not to be limited to the particular embodiments discussed. Thus, the embodiments shall be regarded as illustrative rather than restrictive, and it should be understood that variations may be made in those embodiments by persons skilled in the art without departing from the scope of the invention as set forth in the claims that follow and their structural and functional equivalents.

CLAIMS

What is claimed is:

1. A scan unit for a scanning module, the scan unit comprising:

a holder;

a mirror movable relative to the holder, the mirror for scanning light onto an object;

a magnet movable relative to the mirror, the magnet disposed at least partially within the holder, the magnet for moving the mirror; and

a drive coil disposed at least partially within the holder for moving the magnet.

2. The scan unit of claim 1, wherein said mirror is disposed at least partially outside the holder.

3. The scan unit of claim 1, further comprising:

a flexural member having a first end fixedly attached to the holder;

wherein the mirror and the magnet are fixedly attached to the flexural member.

4. The scan unit of claim 3, wherein the flexural member comprises a torsion spring.

5. The scan unit of claim 3, wherein the holder includes a cage for fixedly attaching the first end of the flexural member to the holder.

6. The scan unit of claim 3, wherein the holder includes a bracket for fixedly attaching the first end of the flexural member to the holder.

7. The scan unit of claim 1, wherein the drive coil includes a core and an electrical conductor wound around the core.

8. The scan unit of claim 7, wherein the core defines a mounting ear for fixedly attaching the drive coil to the holder.

9. The scan unit of claim 7, wherein the core defines first and second mounting ears for fixedly attaching the drive coil to the holder.

10. The scan unit of claim 7, wherein the core is operative as a yoke.

11. The scan unit of claim 1, further comprising:

a flexural member having first and second opposing ends fixedly attached to the holder;

wherein the mirror and the magnet are fixedly attached to the flexural member.

12. The scan unit of claim 11, wherein the flexural member comprises a torsion spring.

13. The scan unit of claim 11, wherein the holder includes a cage for fixedly attaching the first and second ends of the flexural member to the holder.

14. The scan unit of claim 11, wherein the holder includes first and second brackets for fixedly attaching the first and second ends of the flexural member to the holder.

15. A scan unit for a scanning module, the scan unit comprising:

an annular-shaped holder;

a flexural member disposed across a first side of the holder;

a mirror attached to a first side of the flexural member, the mirror for scanning light onto an object;

a magnet attached to a second side of the flexural member; and

a drive coil attached to a second side of the holder, the drive coil for oscillating or vibrating the magnet.

16. The scan unit of claim 15, wherein the flexural member comprises a torsion spring element.

17. The scan unit of claim 15, wherein the holder includes a cage with receptacles for fixedly attaching first and second ends of the flexural member to the holder.

18. The scan unit of claim 15, wherein the holder includes first and second pairs of bracket elements for fixedly attaching the first and second ends of the flexural member to the holder.

19. The scan unit of claim 15, wherein the drive coil has first and second mounting ears for fixedly attaching the drive coil to the holder.

20. A method for making a scan unit, the method comprising:

providing a holder;

providing a light scanning assembly;

inline assembling one of the light scanning assembly and the drive coil to the holder; and

inline assembling the holder to the other one of the light scanning assembly and the drive coil.

21. The method of claim 20, wherein providing the light scanning assembly comprises:

providing a flexural member, a mirror, and a magnet; and

inline assembling the mirror and magnet to the flexural member.

22. A method for making a scan unit, the method comprising:

providing a holder;

providing a light scanning assembly;

inline assembling the light scanning assembly and the drive coil to the holder

23. The method of claim 22, wherein providing the light scanning assembly comprises:

providing a flexural member, a mirror, and a magnet; and

inline assembling the mirror and magnet to the flexural member.

24. The method of claim 22, wherein the inline assembling is performed sequentially.

25. The method of claim 22, wherein the inline assembling is performed concurrently.

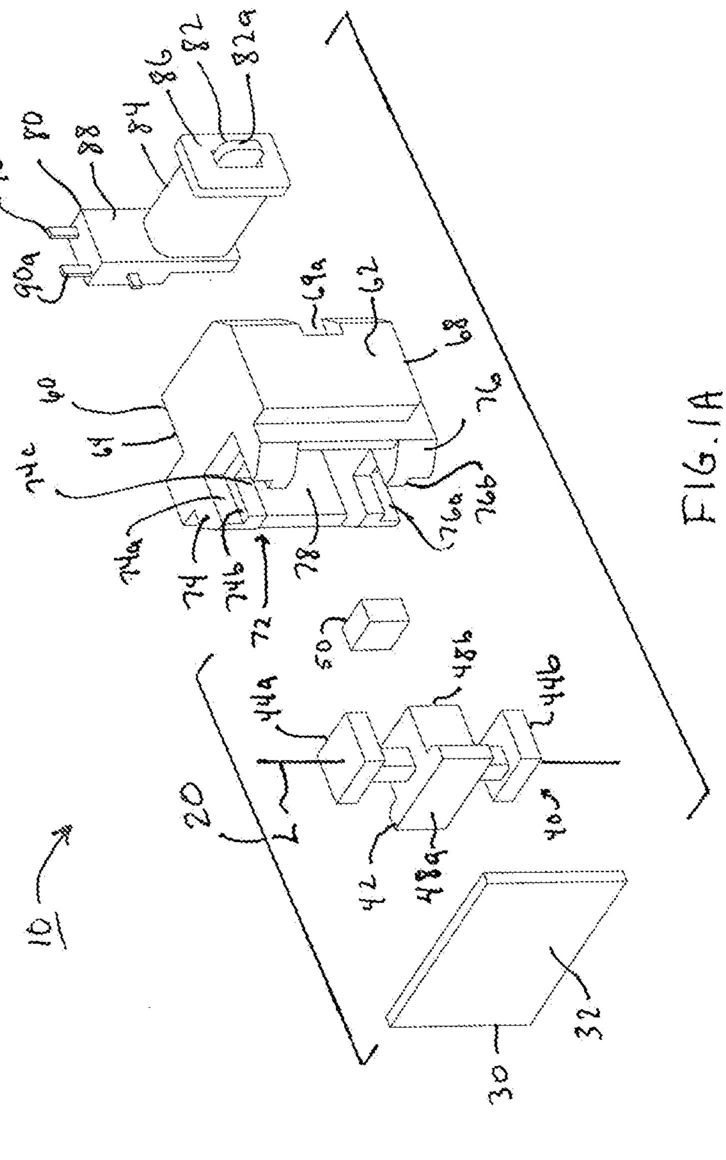
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FIG. 1A

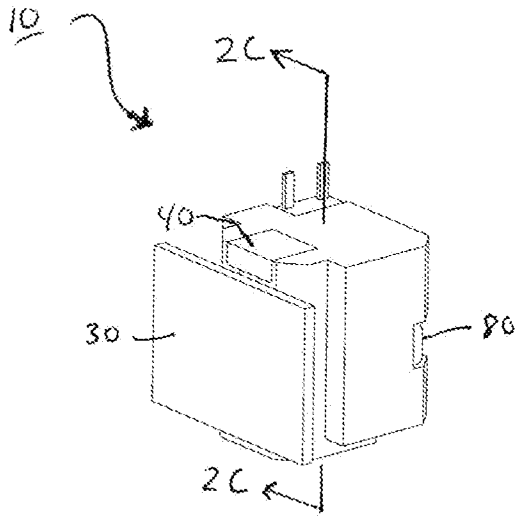

FIG. 1B

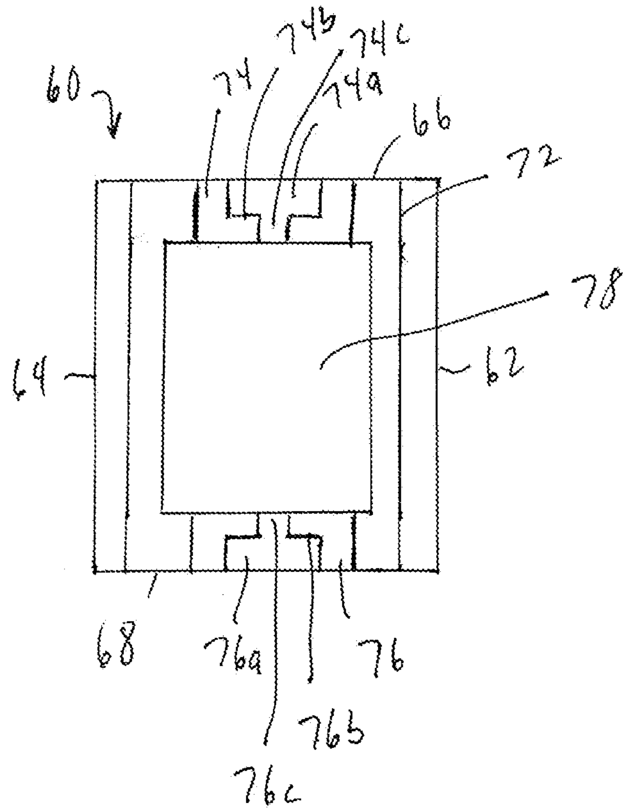
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FIG. 2A

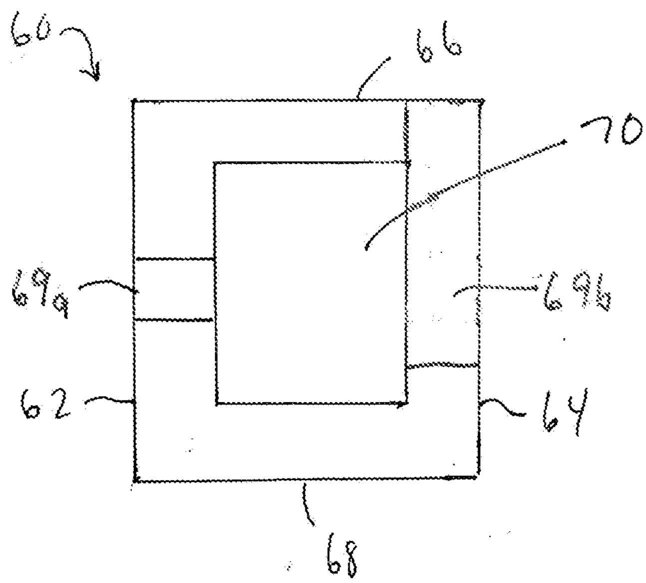
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FIG. 2B

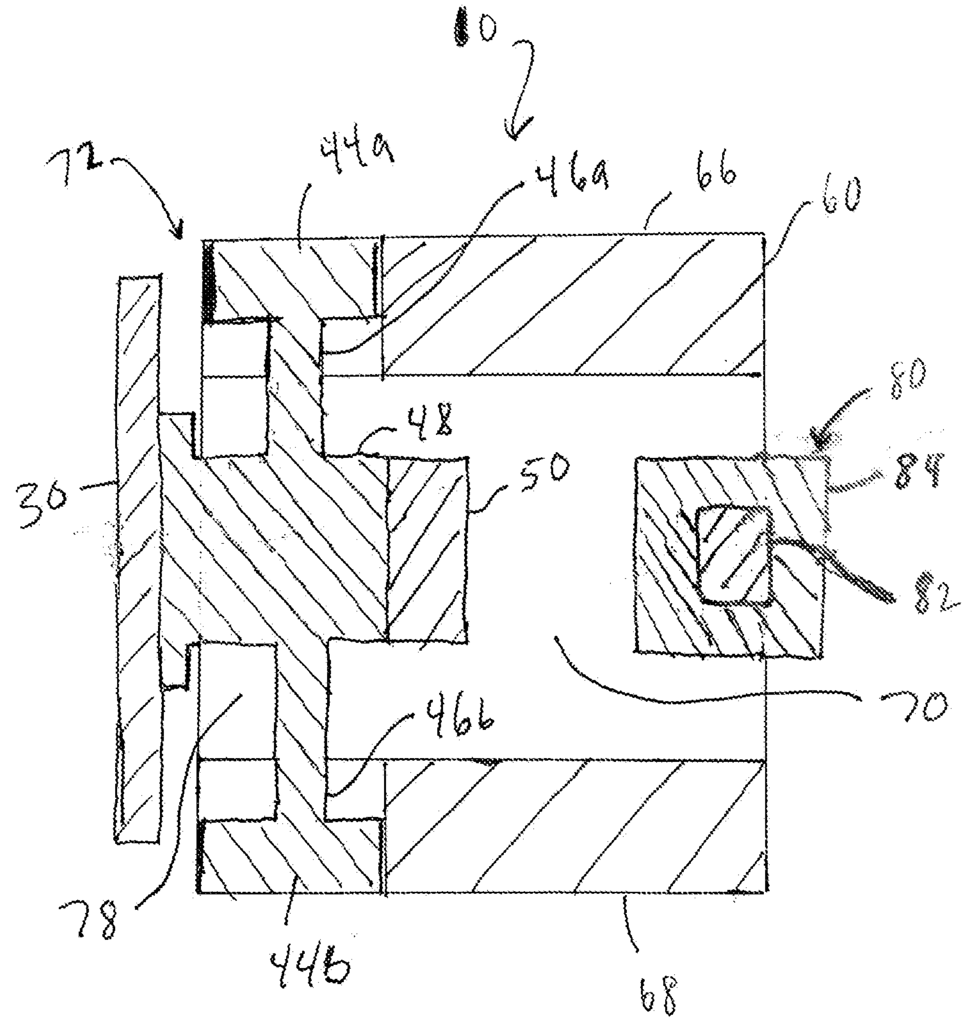


FIG. 2C

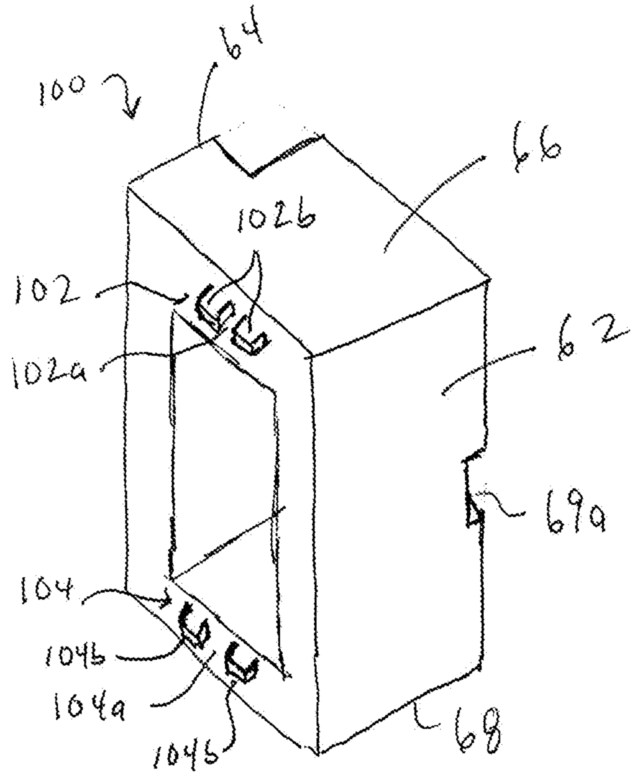


FIG. 3A

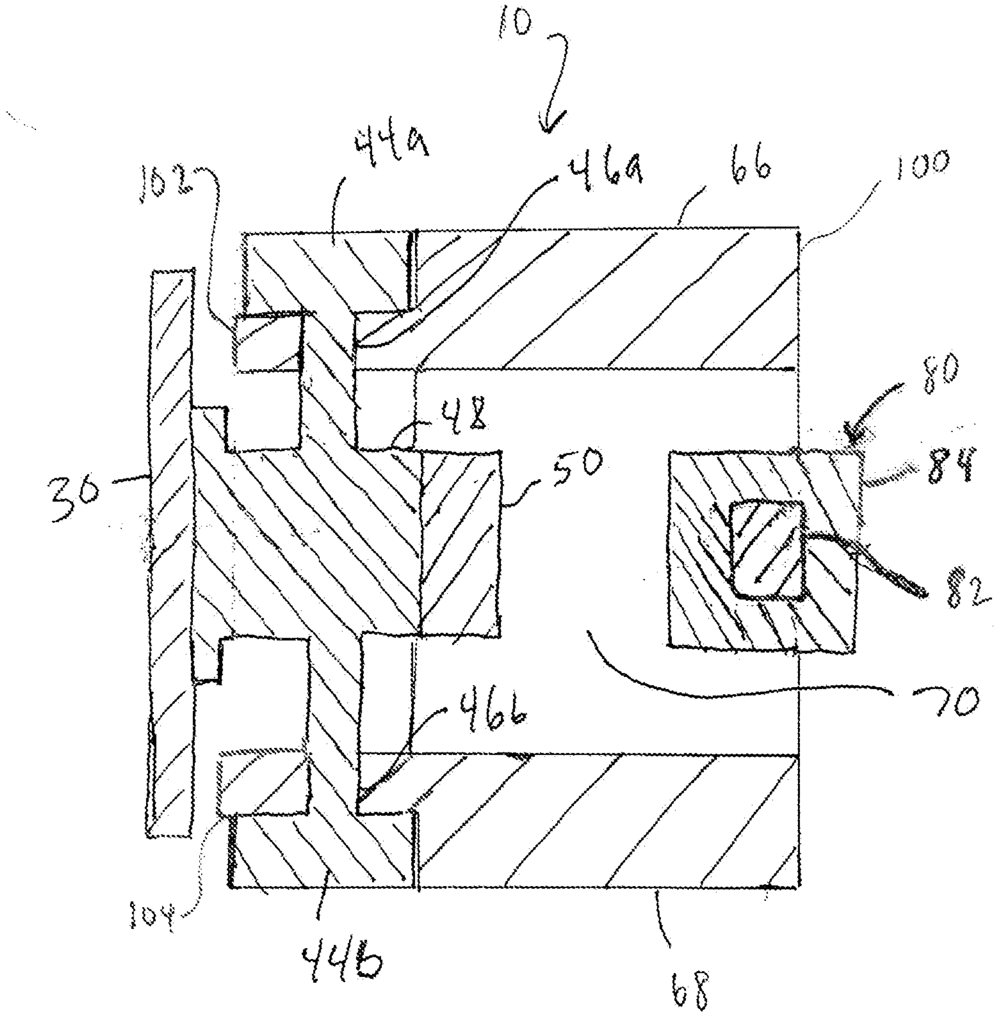


FIG. 3B

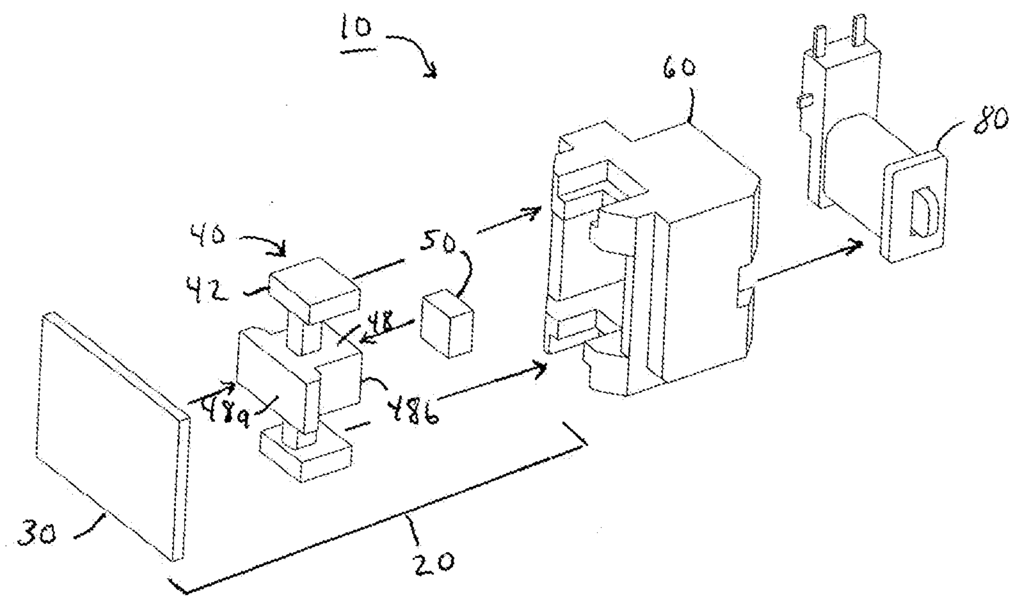


FIG.4A

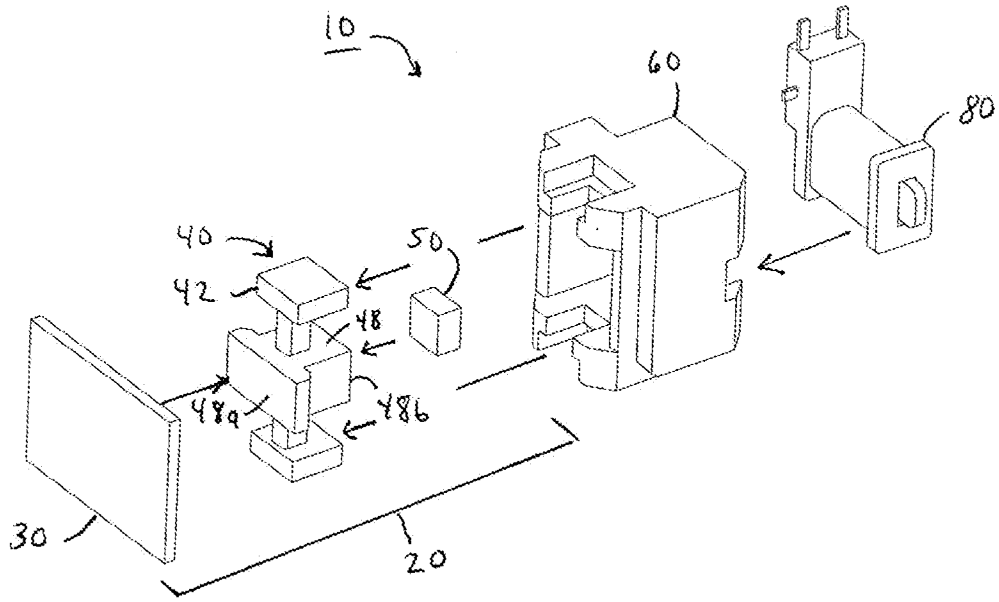


FIG. 4B

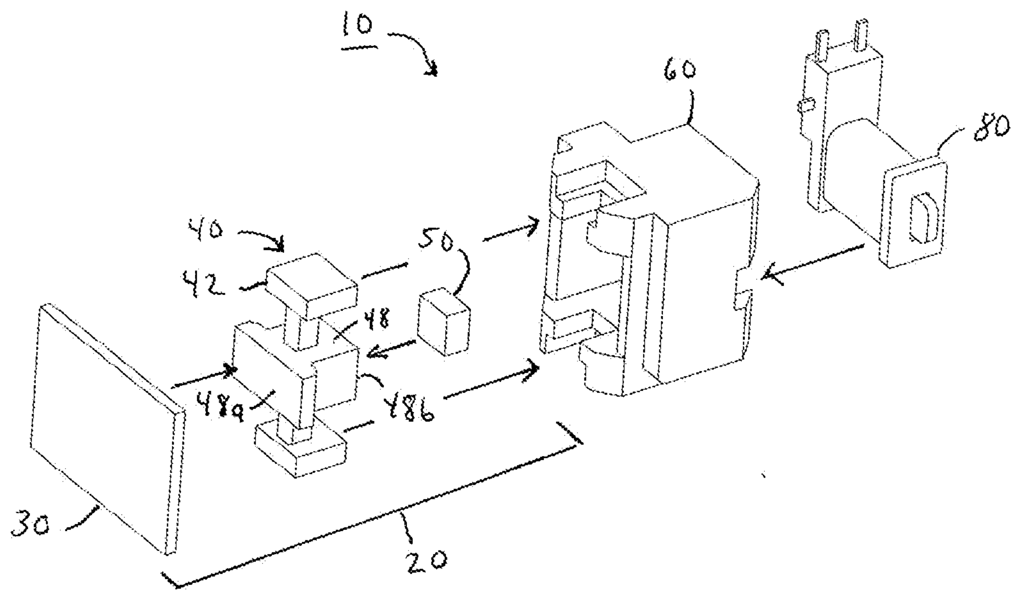
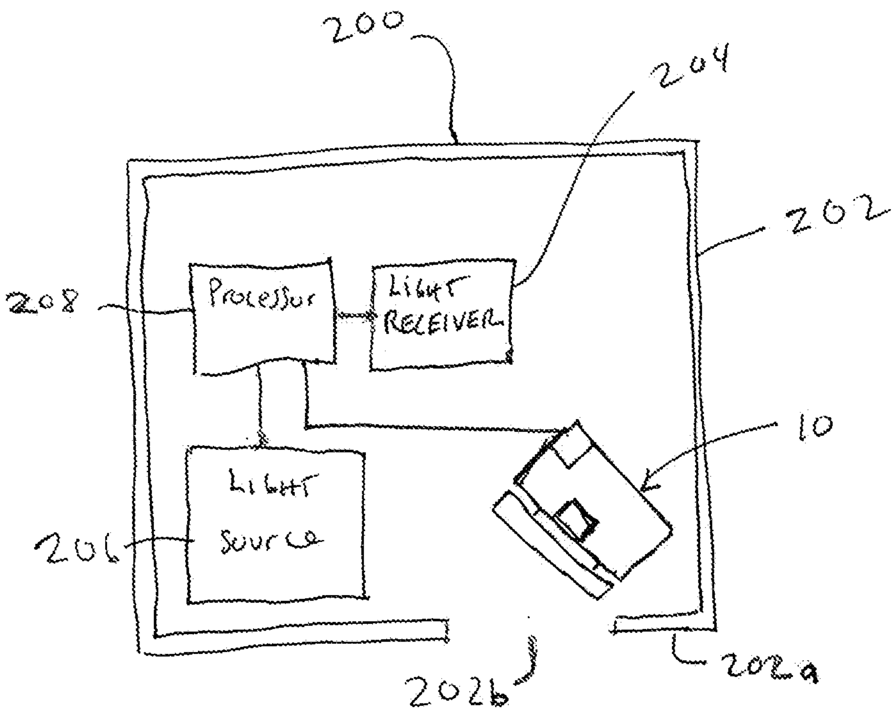


FIG. 4C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Receiver
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202b
202a

FIG. 5