

⑫

**EUROPEAN PATENT SPECIFICATION**

⑬ Date of publication of patent specification: **26.09.84**

⑭ Int. Cl.<sup>3</sup>: **G 11 C 19/08**

⑮ Application number: **81302757.0**

⑯ Date of filing: **18.06.81**

---

⑰ **Cassette type magnetic bubble memory device.**

---

⑱ Priority: **20.06.80 JPU 85573/80**  
**20.06.80 JPU 85574/80**  
**20.06.80 JPU 82801/80**

⑲ Date of publication of application:  
**30.12.81 Bulletin 81/52**

⑳ Publication of the grant of the patent:  
**26.09.84 Bulletin 84/39**

㉑ Designated Contracting States:  
**DE FR GB**

㉒ References cited:  
**EP-A-0 006 446**  
**US-A-4 017 604**  
**US-A-4 156 934**

㉓ Proprietor: **FUJITSU LIMITED**  
**1015, Kamikodanaka Nakahara-ku**  
**Kawasaki-shi Kanagawa 211 (JP)**

㉔ Inventor: **Sukeda, Toshiaki**  
**406-3 Sakata-cho**  
**Suzaka-shi Nagano 382 (JP)**  
Inventor: **Maekawa, Harumi**  
**837-7 Shimoaso Tama-ku**  
**Kawasaki-shi Kanagawa 214 (JP)**  
Inventor: **Takai, Sakan**  
**397-9 Sakata-cho**  
**Sutaka-shi Nagano 382 (JP)**

㉕ Representative: **Abbott, Leonard Charles et al**  
**GILL JENNINGS & EVERY 53-64 Chancery Lane**  
**London WC2A 1HN (GB)**

**EP 0 042 735 B1**

---

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European patent convention).

---

## Description

The present invention relates to a magnetic bubble memory device.

A magnetic bubble memory is non-volatile and has various excellent properties. For example, a high capacity can be obtained using a small size and consumption of electric power is reduced.

An example of a multi-chip magnetic bubble memory assembly is shown in US Specification No. 4017604, which discloses a packaging assembly for magnetic bubble chips having two printed wiring boards between which are mounted module assembly boards carrying magnetic bubble chips, as well as coils; at the end of the printed wiring boards are two sets of terminals for connection to external apparatus.

Magnetic bubble memories are suitable for use for devices such as a data recorder and a voice recorder. These magnetic bubble memory devices are used in the form of a cassette dismountably attached to an external apparatus. In such a magnetic bubble memory device including a bubble cassette, when it is desired to increase the memory capacity of the cassette, this can be attained by increasing the number of devices arranged in the cassette. However, if the number of devices is merely increased, the number of input and output terminals of the cassette is proportionally increased, and therefore, exchangeability of terminals among cassette differing in capacity is lost.

Furthermore, if the number of the devices is increased, the length of the cassette is proportionally increased and dismountable attachability of the cassette to an external apparatus is degraded. For example, when two kinds of cassettes differing in size are inserted into one holder, the cassette having a large capacity protrudes from the holder or the cassette having a small capacity fits deeply in the holder, and handling of the cassettes is very troublesome and use of such cassettes in one holder becomes impossible.

The object of the present invention is to eliminate the foregoing disadvantages.

In accordance with the present invention, there is provided a magnetic bubble cassette assembly comprising a magnetic bubble memory device, including a magnetic memory element, driving coils and means for creating a magnetic biasing field, the device being mounted on a printed board in a case, the cassette assembly having connecting means for connecting the bubble memory device to external apparatus for driving the bubble memory device, characterized in that the cassette assembly comprises one or more than one bubble memory device, the length of the assembly in its direction of insertion into the external apparatus being dependent on the number of bubble memory devices, and in that a single connecting means serves to connect all

the bubble memory devices to the external apparatus and is located at a portion of the peripheral wall of the cassette which lies between the leading and trailing end faces of the cassette, in the said direction of insertion, at a predetermined distance from the trailing end face.

With the cassette assembly according to the present invention, the length of the cassette can be increased by increasing the number of bubble memory devices contained in the case without handling disadvantages such as mentioned above.

Preferably, control circuitry such as function drivers, coil drivers, sensing amplifiers and a selecting circuit for the bubble memory devices is incorporated within the cassette so that the number of terminals for connection to the external drive apparatus is the same for all cassettes no matter how many memory devices they contain.

In order that the invention may be better understood several embodiments of the invention will now be described with reference to the accompanying drawings, wherein:—

Figure 1 is a diagram illustrating the principle of the magnetic bubble;

Figure 2 is a partially cut-away perspective view showing one example of a magnetic bubble memory device;

Figure 3 is a fragmentary perspective view showing one embodiment of the magnetic bubble memory cassette according to the present invention;

Figure 4 is a perspective view illustrating another embodiment of the magnetic bubble memory cassette according to the present invention;

Figure 5 is a diagram illustrating the state where the magnetic bubble memory cassette shown in Figure 3 is actually used;

Figure 6 is a diagram illustrating the state where the magnetic bubble memory cassette shown in Figure 4 is actually used;

Figure 7 is a sectional view illustrating still another embodiment of the magnetic bubble memory cassette according to the present invention;

Figure 8 is a diagram illustrating the state where the magnetic bubble memory cassette shown in Figure 7 is actually used;

Figure 9 is a sectional view showing still another embodiment of the magnetic bubble memory cassette according to the present invention;

Figure 10 is a sectional view showing an extension cassette to be attached to the magnetic bubble memory cassette shown in Figure 9; and

Figure 11 is a fragmentary perspective view illustrating still another embodiment of the magnetic bubble memory cassette according to the present invention.

Magnetic films ordinarily have an easy magnetisation axis of the magnetic domain in

the in-plane direction, but some magnetic materials, for example, single crystals of orthoferrite or magnetic garnet, have such a strong monoaxial anisotropy that an easy magnetisation axis is present only in the direction of axis C. When such material having a vertical plane on axis C is formed into a film, if a magnetic field is not applied from the outside, as shown in Figure 1-(a), magnetic domains 1 of an upward magnetisation direction and magnetic domains 2 of a downward magnetisation direction are mingled alternately in a striped pattern, the total area of the magnetic domains 1 being substantially equal to the total area of the magnetic domains 2. When a downward bias magnetic field HB is applied to this film, the upward magnetic domains 1 are decreased but the downward magnetic domains 2 are expanded, and through the state shown in Fig. 1-(b), the upward magnetic domains 1 are finally converted to a small columnar magnetic domain 3 having a diameter of several  $\mu\text{m}$ . This magnetic domain 3 is called "a magnetic bubble domain" and this magnetic domain 3 can freely be moved within the magnetic film according to the gradient of the bias magnetic field. Therefore, this film is utilized as a memory element. An example of a magnetic bubble memory device utilizing this magnetic bubble is shown in Fig. 2. This device will now be described in brief. A chip 4 having a magnetic film is mounted on an insulating substrate 5, and driving coils 6 and 7 are disposed around the chip 4 at right angles to each other so as to impart a horizontal rotary magnetic field to the chip 4. Permanent magnets 8 and 9 and magnetic adjuster plates 10 and 11 are arranged above and below the driving coils 6 and 7 to apply a bias magnetic field to the chip 4, and these members are charged in a magnetic shield case 12 also acting as a yoke.

An example of a bubble cassette containing therein a magnetic bubble memory device as described above is illustrated in Fig. 3. The magnetic bubble memory device 13 is mounted on a printed board 15, and a connector 14 for connecting the magnetic bubble memory device 13 to an external apparatus (not shown) for reading and/or writing is disposed on the printed board 15. Many connecting terminals 19 are arranged in parallel on the top surface of the connector 14. This printed board 15 is contained in a case including an upper case 16 and a lower case 17, and a bubble cassette 27 is thus fabricated. This bubble cassette 27 is inserted into an external apparatus (not shown) in a direction indicated by an arrow P. An opening 18 is formed on the top surface of the upper case 16 so that the terminals 19 of the connector 14 are exposed through this opening 18.

When the bubble cassette 27 is actually used, it is inserted into a holder 26 of an external apparatus 25, as shown in Fig. 5.

Contact terminals 28 having elasticity, which are disposed in parallel in this holder 26 in correspondence to the respective terminals 19, are pressed to fall in contact with the corresponding terminals 19 of the connector 14 of the bubble cassette, whereby the bubble cassette 27 is electrically connected to the external apparatus 25.

If it is desired to increase the memory capacity of such magnetic bubble memory cassette, this object can be attained by increasing the number of bubble memory devices 13 mounted on the printed board 15. A bubble cassette having a memory capacity thus increased is illustrated in Fig. 4. Four bubble memory devices 13, the connector 14 and electronic parts 23 and 24 for selecting and driving the bubble memory devices 13 are disposed on the printed board 15. This bubble cassette 22 is different from the cassette shown in Fig. 3 in that three additional bubble memory devices 13 are mounted in front of the connector 14 with respect to the insertion direction P. As shown in Fig. 6, this bubble cassette 22 is inserted in the holder 26 of the external apparatus 25 and is used in this state. As is seen from Fig. 6, the length l of the bubble cassette 22 projecting from the front surface of the external apparatus is the same as in case of the bubble cassette shown in Fig. 5. By appropriately setting the length of the holder 26, the position of the connector 14 in the bubble cassette and the positions of the contact terminals 28 in the holder, the length l can be adjusted to a length most suitable for the operations of inserting and withdrawing the cassette. In other words, even if the entire length of the cassette is changed by increasing or decreasing the number of the bubble memory devices 13, the operation adaptability of the cassette is not impaired.

Fig. 7 is a sectional view showing another embodiment of the magnetic bubble memory cassette according to the present invention. In this embodiment, a plug/jack connector of the insertion type is used instead of the connector of the press-contact type used in the foregoing embodiments. Referring to Fig. 7, a magnetic bubble memory device 13 and a connector 20 are disposed on a printed board 15, and this assembly is contained between upper and lower cases 16 and 17. The connector 20 is disposed at the rear end portion, with respect to the insertion direction indicated by an arrow P, of the cassette and projects from the top surface of the cassette, and a plug 21 of the connector 20 is arranged in the direction of insertion into the external apparatus and is directed thereto. In the embodiment shown in Fig. 7, one bubble memory device 13 is disposed. When it is desired to increase the memory capacity, the printed board 15 and cases 16 and 17 are increased in the length and a plurality of bubble memory devices 13 are disposed.

The cassette of this embodiment having the

above-mentioned structure is inserted in a holder 26 of the external apparatus as shown in Fig. 8, and the cassette is used in this state. In case of either a cassette 29 having a small capacity or a cassette 30 having a large capacity, the plug 21 is connected to a jack 31 mounted on the holder 26. Accordingly, the projection length *l* from the holder 26 is the same in these cassettes 29 and 30 irrespectively of the memory capacity. Accordingly, dismountable attachability of the cassettes is improved and this improved dismountable attachability is similarly maintained in the respective cassettes.

Embodiments of means for increasing the number of bubble memory devices for increasing the memory capacity in the magnetic bubble memory device according to the present invention are illustrated in Figs. 9 through 11. In an embodiment shown in Fig. 9, a connector (jack) 32 for increasing the memory capacity is mounted on the front end portion of the cassette with respect to the direction of insertion of the cassette. A connector (plug) 34 of an additional cassette 35 (Fig. 10) is coupled to the jack 32 of the main cassette 33 having a connector 20 for connection to the external apparatus. One magnetic bubble memory device 13 is mounted on a printed board in this additional cassette 35, and the jack 32 and plug 34 are disposed on the front and rear ends, respectively. If a plurality of additional cassettes 35 having the above-mentioned structure are connected to the front portion of the main cassette, as in the foregoing embodiments, the memory capacity can easily be increased without degradation of the operation adaptability of the cassettes at the inserting and withdrawing steps. It is preferred that the additional cassettes 35 be fixed to the main cassette 33 and to one another by screws 37 as shown in Fig. 11. If this arrangement is adopted, the respective additional cassettes are integrated into a cassette assembly and this assembly can be attached to and withdrawn from the external apparatus assuredly without separation of the assembly into the respective cassettes. A lid 36 may be mounted on the jack 32 of the additional cassette 35 located at the front end. The main connector 33 shown in Fig. 11 is of the type provided with a press-contact type connector.

Preferably peripheral circuits which are disposed in the external apparatus according to the conventional techniques, such as function drivers, coil drivers, sensing amplifiers and selecting circuits, are included within the bubble cassette, so that even if the number of bubble devices is increased in one cassette, the number of connection terminals to the external apparatus is not changed and cassette exchangeability is conveniently attained.

As will be apparent from the foregoing description, exchangeability of bubble cassettes differing in the memory capacity is attained

according to the present invention, and the present invention makes great contributions to expansion of the application fields and ranges of the magnetic bubble memory device.

In the present invention, connector contact portions are formed on the peripheral wall of the bubble cassette except the front and rear end faces with respect to the insertion direction of the cassette, and function drivers, coil drivers and sensing amplifiers for driving magnetic bubble devices are disposed in the interior of the cassette. Accordingly, the memory capacity can be increased by increasing the number of the magnetic bubble devices without increasing the number of the terminals of the connector. Moreover, even if the length of the cassette is increased by disposition of additional devices, the cassette can easily be handled without any trouble when it is actually used.

### Claims

1. A magnetic bubble cassette assembly (27, Figure 3; 22, Figure 4; 33 and 35, Figure 11;) comprising a magnetic bubble memory device (13), including a magnetic memory element (4), driving coils (6, 7) and means for creating a magnetic biasing field (8, 9), the device being mounted on a printed board (15) in a case (16, 17), the cassette assembly having connecting means (14) for connecting the bubble memory device to external apparatus for driving the bubble memory device, characterized in that the cassette assembly comprises one or more than one bubble memory device, the length of the assembly in its direction of insertion into the external apparatus being dependent on the number of bubble memory devices, and in that a single connecting means (14) serves to connect all the bubble memory devices to the external apparatus and is located at a portion of the peripheral wall of the cassette which lies between the leading and trailing end faces of the cassette, in the said direction of insertion, at a predetermined distance from the trailing end face.

2. A magnetic bubble cassette assembly in accordance with claim 1, wherein the connecting elements (19, 21) of the said connecting means (14) extend in a direction parallel to the insertion direction.

3. A magnetic bubble cassette assembly in accordance with claim 1 or 2, wherein the said connecting means (14) is located on a portion of the peripheral wall of the cassette which lies in a plane containing the direction of insertion of the cassette (Figure 3).

4. A magnetic bubble cassette assembly in accordance with any preceding claim, wherein the connecting elements are of the press-contact type.

5. A magnetic bubble cassette assembly in accordance with claim 1 or 2, wherein the said connecting means (14) lie in a portion of a peripheral wall of the cassette extending

perpendicularly to the said direction of insertion. (Figure 7).

6. A magnetic bubble cassette assembly in accordance with claim 5, wherein the connecting element (21) is of the plug/jack type.

7. A magnetic bubble cassette assembly in accordance with any preceding claim, wherein a first cassette (33, Figures 9 and 11) has a connector (32) at its leading end face, the connector being mounted on the printed circuit (15), and wherein an additional cassette (35, Figures 10 and 11) has a connector (34) on its trailing end face, coupled with the connector on the leading end face of the first cassette.

#### Patentansprüche

1. Magnetblasenkassettenanordnung (27, Figur 3; 22, Figur 4; 33 und 35 Figur 11;), mit einer Magnetblasenspeichereinrichtung (13), mit einem magnetischen Speicherelement (4), Treiberspulen (6, 7) und Mitteln zur Erzeugung eines magnetischen Vorspannungsfeldes (8, 9),

bei welcher die Einrichtung auf einer gedruckten-Karte (15) in einem Gehäuse (16, 17) angeordnet ist, und die Kassettenanordnung Verbindungseinrichtungen (14) zum Anschluß der Blasenspeichereinrichtung an einer externen Vorrichtung zum Treiben der Blasenspeichereinrichtung hat,

dadurch gekennzeichnet, daß die Kassettenanordnung eine oder mehrere Blasenspeichereinrichtungen hat, die Länge der Kassette in ihrer Einschubrichtung in die externe Vorrichtung von der Zahl der Blasenspeichereinrichtungen abhängt, und daß eine einzige Verbindungseinrichtung (14) dazu dient, alle Blasenspeichereinrichtungen mit der externen Vorrichtung zu verbinden, und an einem Abschnitt der peripheren Wand der Kassette angeordnet ist, welche zwischen der vorderen Endfläche und der hinteren Endfläche der Kassette, in der genannten Einschubrichtung, in einem vorbestimmten Abstand von der hinteren Endfläche liegt.

2. Magnetblasenkassettenanordnung nach Anspruch 1, bei welcher die Verbindungselemente (19, 21) der genannten Verbindungseinrichtungen (14) sich in eine Richtung parallel zu der Einschubrichtung erstrecken.

3. Magnetblasenkassettenanordnung nach Anspruch 1 oder 2, bei welcher die genannte Verbindungseinrichtung (14) auf einem Abschnitt der peripheren Wand der Kassette angeordnet ist, welche in einer Ebene liegt, die die Richtung des Kassetteneinschubs (Figur 3) enthält.

4. Magnetblasenkassettenanordnung nach einem der vorhergehenden Ansprüche, bei welcher die Verbindungselemente vom Druckkontakttyp sind.

5. Magnetblasenkassettenanordnung nach Anspruch 1 oder 2, bei welcher die genannten Verbindungseinrichtungen (14) in einem Abschnitt der peripheren Wand der Kassette

liegen, der sich rechtwinklig zu der genannten Einschubrichtung (Figur 7) erstreckt.

6. Magnetblasenkassettenanordnung nach Anspruch 5, bei welcher die Verbindungselemente (21) vom Steckertyp sind.

7. Magnetblasenkassettenanordnung nach einem der vorhergehenden Ansprüche, bei welcher eine erste Kassette (33, Figuren 9 und 11) ein Verbindungsteil (32) an seiner vorderen Endfläche hat, das Verbindungsteil auf der gedruckten Schaltung (15) montiert ist, und bei welcher eine zusätzliche Kassette (35, Figuren 10 und 11) an ihrer hinteren Endfläche ein Verbindungsteil (34) hat, welches mit dem Verbindungsteil an der vorderen Endfläche der ersten Kassette gekoppelt ist.

#### Revendications

1. Une structure de cassette à bulles magnétiques (27, figure 3; 22, figure 4; 33 et 35, figure 11) comprenant un dispositif de mémoire à bulles magnétiques (13), contenant un élément de mémoire magnétique (4), des bobines de commande (6, 7) et des moyens pour créer un champ magnétique de polarisation (8, 9), le dispositif étant monté sur une plaquette de circuit imprimé (15) dans un boîtier (16, 17), et la structure de cassette comprenant un moyen de connexion (14) destiné à connecter le dispositif de mémoire à bulles à un appareil externe, pour commander ce dispositif, caractérisée en ce que la structure de cassette comprend un ou plusieurs dispositifs de mémoire à bulles, la longueur de la structure dans sa direction d'insertion dans l'appareil externe dépendant du nombre de dispositifs de mémoire à bulles, et en ce qu'un seul moyen de connexion (14) est utilisé pour connecter tous les dispositifs de mémoire à bulles à l'appareil externe et est placé dans une partie de la paroi périphérique de la cassette qui se trouve entre les faces d'extrémité avant et arrière de la cassette, dans la direction d'introduction, à une distance prédéterminée de la face d'extrémité arrière.

2. Une structure de cassette à bulles magnétiques selon la revendication 1, dans laquelle les éléments de connexion (19, 21) du moyen de connexion (14) s'étendent dans une direction parallèle à la direction d'insertion.

3. Une structure de cassettes à bulles magnétiques selon la revendication 1 ou 2, dans laquelle le moyen de connexion (14) se trouve sur une partie de la paroi périphérique de la cassette qui est située dans un plan contenant la direction d'insertion de la cassette (figure 3).

4. Une structure de cassette à bulles magnétiques selon l'une quelconque des revendications précédentes, dans laquelle les éléments de connexion sont du type à contact à pression.

5. Une structure de cassette à bulles magnétiques selon la revendication 1 ou 2, dans laquelle le moyen de connexion (14) se trouve dans une partie d'une paroi périphérique de la

cassette qui s'étend perpendiculairement à la direction d'insertion (figure 7).

6. Une structure de cassette à bulles magnétiques selon la revendication 5, dans laquelle l'élément de connexion (21) est du type mâle/femelle.

7. Une structure de cassette à bulles magnétiques selon l'une quelconque des revendications précédentes, dans laquelle une première

cassette (33, figures 9 et 11) comporte un connecteur (32) sur sa face d'extrémité avant, ce connecteur étant monté sur le circuit imprimé (15), et dans laquelle une cassette supplémentaire (35, figure 10 et 11) comporte un connecteur (34) qui se trouve sur sa face d'extrémité arrière et qui est connecté au connecteur de la face d'extrémité avant de la première cassette.

5

10

15

20

25

30

35

40

45

50

55

60

65

6

Fig. 1

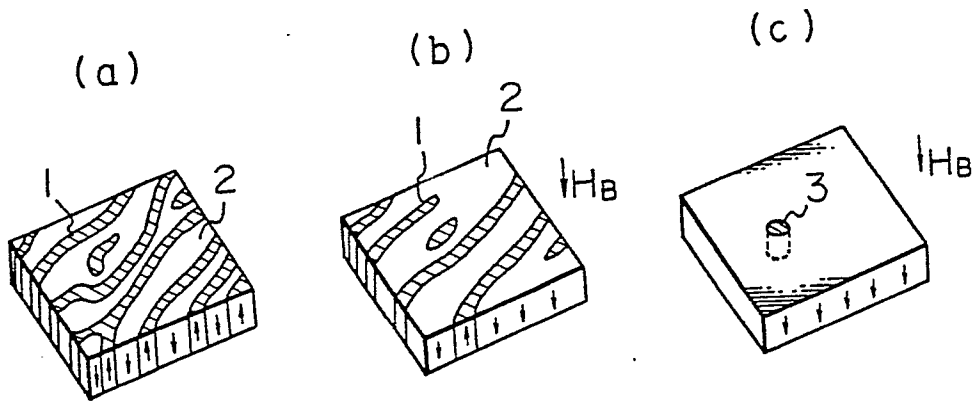


Fig. 2

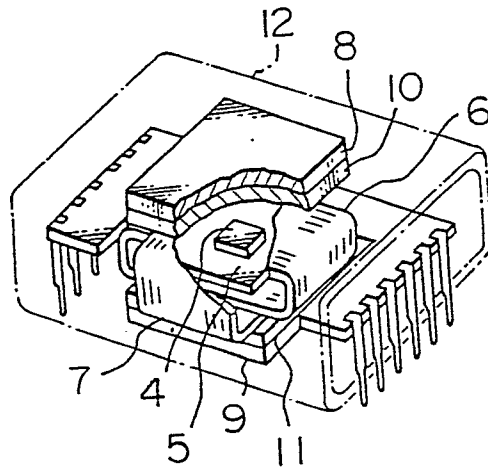


Fig. 3

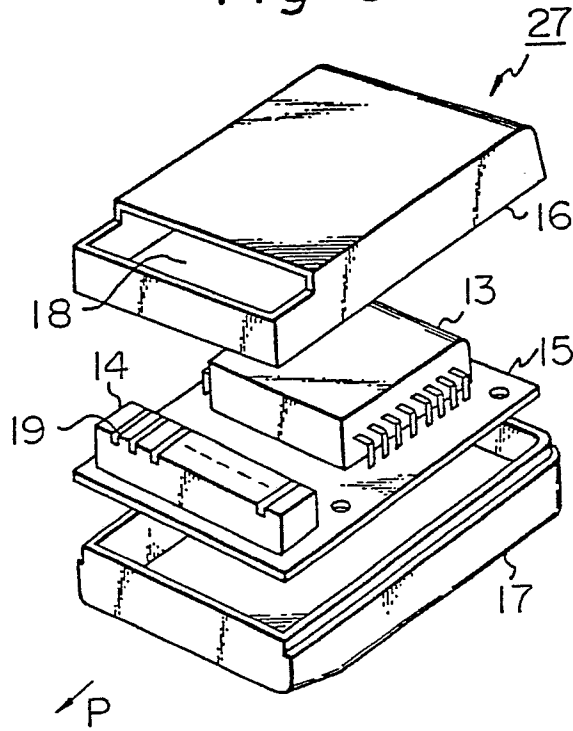


Fig. 4

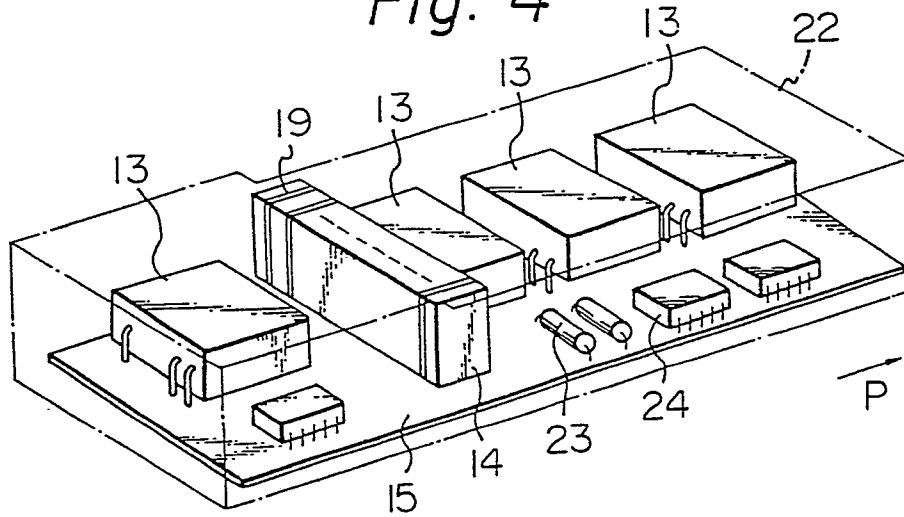




Fig. 5

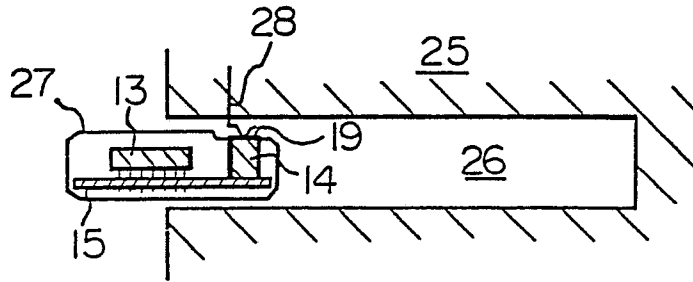


Fig. 6

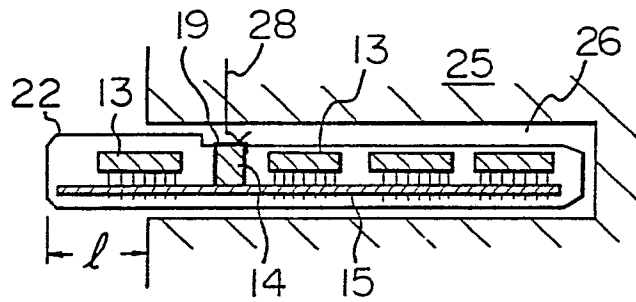


Fig. 7

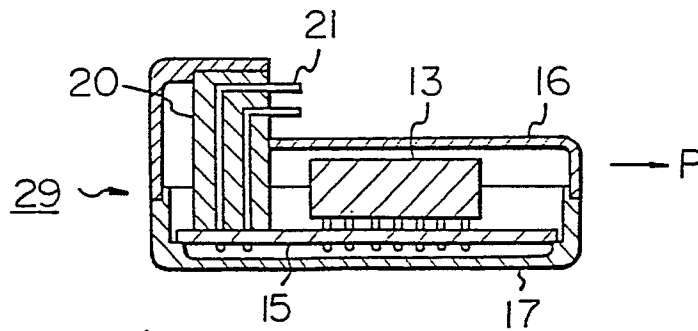


Fig. 8

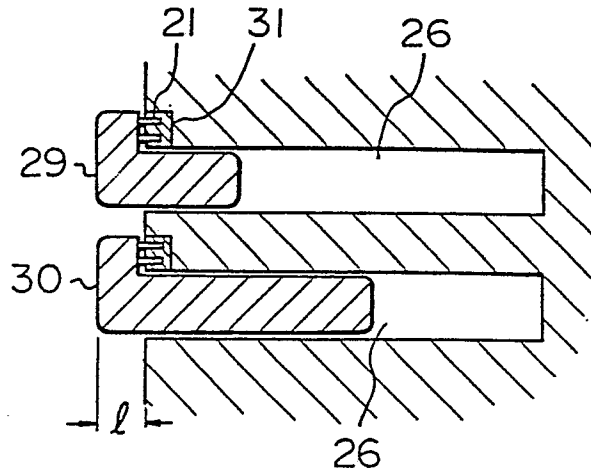


Fig. 9

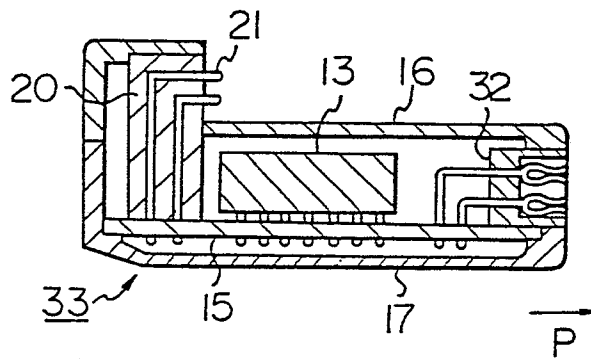


Fig. 10

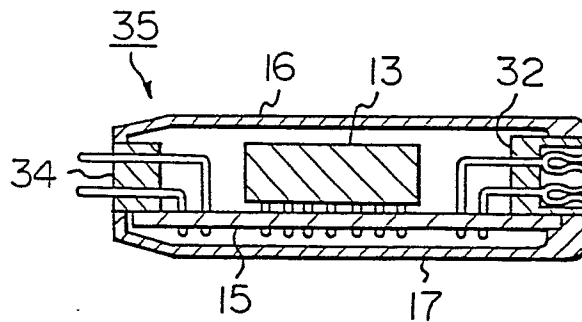


Fig. 11

