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(54) MODULAR ELECTRONIC SIGN SYSTEM

MODULARES ELECTRONICHES ANZEIGESYSTEM

SYSTEME DE SIGNALISATION ELECTRONIQUE MODULAIRE

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Description

Field of the Invention

This invention relates generally to microstrip antenna systems. More specifically, this invention relates to a removable electromagnetic connection system for microstrip antennas, electronic signs and electronic license plates. This invention further relates to modular integrated electronic signs.

Background of the Invention

Electronic sign systems or electronic license plate systems for roadside to vehicle communication or vehicle to vehicle communication, are being developed as the need for more advanced and efficient traffic management arises. These systems typically employ visual information for drivers to read, such as traditional license plate information or road condition information, as well as electronic or electromagnetic information, which is transmitted from one antenna system to another. For example, for roadside to vehicle communication, or in-vehicle signing, a first antenna system transmits information associated with a road sign, such as a STOP sign, and a second antenna system located within a vehicle receives the information and communicates it to the driver, either audibly, through a speaker within the vehicle, or visibly, through a display located in the vehicle. Such systems can transmit redundant information, thereby attempting to ensure all drivers receive the information, even in poor weather conditions where visibility is poor or if drivers have deteriorating eyesight. The systems are also capable of transmitting variable information, depending on the circumstances. For vehicle to vehicle communication, a first antenna system is located within a first vehicle. The first antenna system may transmit redundant information associated with traditional license plates, such as a vehicle's unique alphanumeric identifier, the state in which the vehicle is registered, and the date the registration expires. The first antenna system can further transmit additional information, such as the validity of required on-board documents, such as insurance, registration or emission certificates.

Electronic license plate and sign systems may utilize their electronic communication capabilities for a variety of other purposes, including automatic restriction of areas to certain vehicles, traffic control, vehicle theft protection, toll collection, collision avoidance and emergency message communication. Depending on the application, the electronic license plates or signs may have a relatively simple configuration or a more complex configuration. For example, the simplest system would be a passive, backscatter system which provided essentially the same information as that provided visually by present license plates. Such a system could also indicate the existence and validity of other on-board docu-

ments. More complex systems could include WORM-type (write-once-read-many) memories or RAM-type (random access memory) read-write memories, depending on the complexity of the application. The more complex systems could require access to the electronics, possibly requiring disassembly of the electronic license plates or signs for changing the electronics or batteries or reprogramming the electronics. Further, it would be desirable for systems to be modular, such that changing between applications of different complexity is easily achieved.

One type of antenna system used for electromagnetic communication in electronic signing is a microstrip antenna system. Microstrip antennas are well-suited for electronic signing applications because of their low profile. A simple microstrip antenna typically consists of a rectangular metallic patch printed on a thin, grounded dielectric substrate with a coaxial probe feed through the bottom of the substrate. Alternative feeding methods have been developed which utilize noncontacting feed structures. One example of a noncontacting feed is an aperture coupled microstrip antenna. This antenna uses two parallel dielectric substrates separated by a ground plane. A microstrip feed line on the bottom substrate is coupled through a small aperture in the ground plane to a microstrip patch on the top substrate. A coaxial line then feeds the microstrip feed line. To connect microstrip antennas to external modules, such as external power sources or electronics, a coaxial connector is connected to the microstrip feed line, thereby providing an electrical connection. The external modules are then electrically connected at the other end of the coaxial line. Electronic signs and license plates are exposed to temperature and weather extremes, and thus the connection to the electronic signs most likely break at the physical coaxial connection, the weakest point structurally in the connection scheme. Therefore, it is desirable for a more reliable connection scheme for electronic signs.

What is further desirable is a modular electronic sign. For example, in a configuration where a connector has not been connected to the electronic sign, the sign continues to communicate information visually. When the connector has been connected to the electronic sign, however, the sign communicates information both electronically and visually. Further, in another configuration, by connecting different connectors, different electronic information may be transmitted. Modular signs reduce cost because as different electronics are connected to the sign, for purposes such as transmitting different messages, for advances in electronics, or for maintenance or repairs, only a portion of the sign may be changed without changing the entire sign. For example, in electronic signs utilizing coaxial connectors, the entire antenna, feed structure and possibly the electronics all reside in a single unit contained within the sign. Therefore, to perform maintenance, the coaxial connector is removed and the entire sign is taken down.

Aperture coupling results in many advantages, in-

cluding independent optimization of both the feed and the radiation functions. Microstrip antenna systems have been integrated into retroreflective signs and license plates, as described in commonly-assigned U.S. Patent Application Serial Number 08/196,294 to Bantli et al., filed February 11, 1994. It is preferable to integrate an antenna or receiver with a road sign to prevent obstacle congestion on the road side, to be able to use existing infrastructure to implement the electronic road signs, for ease of installation, to reduce cost and for safety considerations. Similarly, it is preferable to integrate an antenna or receiver with a license plate for ease of installation, for the ability to use existing structures on vehicles for installation, to optimize antenna location for low power communication between the roadside and the vehicle and to ensure that the visual and electronic information is consistent.

Summary of the Invention

To overcome the limitations in the prior art described above, and to overcome other limitations that will become apparent upon reading and understanding the present specification, the present invention provides a removable electromagnetic connection system for microstrip antennas. The microstrip antenna system includes a first antenna portion, a second antenna portion and a connector for removably connecting the first and second antenna portions. The first antenna portion includes a microstrip patch mounted on a dielectric substrate. The other side of the dielectric substrate has a first conductive substrate acting as a ground plane for the microstrip patch, the ground plane having an opening aligned with the microstrip patch. The second antenna portion has a second conductive substrate on a second dielectric substrate, the second conductive substrate having an aperture therethrough, the aperture aligned with the opening in the first conductive substrate. The second dielectric substrate has a microstrip transmission line on the other side for a feed structure. The opening in the first conductive substrate is sized to accommodate the aperture such that when the connector connects the first and second antenna portions, the aperture electromagnetically couples the microstrip patch and the microstrip transmission line. Such a microstrip antenna system is particularly useful in application such as electronic signs and electronic license plates.

Brief Description of the Drawings

The present invention will be more fully described with reference to the accompanying drawings wherein like reference numerals identify corresponding components, and:

Figure 1 is a perspective view of a roadway intersection having integrated electronic signs, and having vehicles having integrated electronic license

plates;

Figures 2, 2A and 2B show a front view, a side cross-sectional view and an exploded view of an embodiment of the modular electronic sign system of the present invention;

Figure 3 shows a partially exploded view of the modular microstrip antenna system of the present invention;

Figures 4 and 4A show the interface portion of the modular electronic sign system and with the dielectric substrate removed, as well as a perspective cross-sectional view of the interface portion;

Figure 5 shows the interface portion of the modular electronic sign system and with the dielectric substrate removed to show electronics mounted thereon;

Figure 6 shows the interface portion of the modular electronic sign system and the front and back sides the removed dielectric substrate;

Figures 7, 7A and 7B show a front view, a side cross-sectional view, and an exploded view of an electronic license plate embodiment of the present invention; and

Figures 8, 8A and 8B show a front view, a side cross-sectional view, and an exploded view of another embodiment of the present invention.

Detailed Description of a Preferred Embodiment

To overcome the limitations in the prior art described above, and to overcome other limitations that will become apparent upon reading and understanding the present specification, the present invention provides a removable electromagnetic connection system for microstrip antennas which may be utilized in modular integrated electronic license plate and sign systems. Referring to Figure 1, a perspective view of a roadway intersection is shown. Integrated electronic signs 2, in the form of a STOP sign and a street sign, communicate information to drivers of vehicles both visually and electromagnetically. Signs 2 are connected by cable 4 to interface unit 6, which may include a power source, electronics or a communication interface with a central traffic management center. Interface unit 6 is preferably buried in the ground to avoid congesting the roadside and to protect the components within the unit. Vehicles in the form of bus 10 and truck 12 include integrated electronic signage in the form of license plates (not shown.) Antennas within signs 2 radiate fields 8, which communicate information electromagnetically. The electronic license plate of bus 10 is interactive, with a receive and a send mode, and radiates field 14 when sending information electromagnetically. The electronic license plate of truck 12, however, includes a less complex antenna system such as a passive backscatter system, and does not radiate a field.

Referring to Figures 2, 2A and 2B, a front view, a side cross-sectional view and an exploded view of mod-

ular integrated electronic sign 2, in the form of a STOP sign, are shown. Modular integrated electronic sign 2 is separated into a display portion 16 and a modular interface portion 18. Display portion 16 attaches to existing sign infrastructure, such as poles. Display portion 16 of sign 2 conveys information visually by printed information 20. In many signs, printed information 20 is placed on a retroreflective surface, such as retroreflective sheeting 22, to enhance the ability of the driver to locate and read the printed information on the sign at night. Referring to Figures 2A, 2B, and 3, rectangular microstrip patch 24 is printed, etched, laminated or secured using other standard techniques, onto dielectric substrate 26 and is spaced from ground plane 28 by dielectric substrate 26. For example, microstrip patch may be adhesive backed copper film secured to a foam dielectric with a dielectric constant of 1.1. Ground plane 28 may be any suitable conductive substrate, such as copper or aluminum. It is well known in the art that more than one microstrip patch, or an array of patches may be used as radiating elements. Ground plane 28 includes hole 30 which is aligned with microstrip patch 24.

Interface portion 18 of modular integrated electronic sign 2 provides a feed network for the microstrip antenna as well as providing an interface to external components for display portion 16, such as to a power source and electronics. The feed network of interface portion 18 couples the radiating elements 24 or the antenna to a microstrip transmission line by aperture coupling. Interface portion 18 includes aperture plate 40, constructed of a conductive substrate, such as copper. Aperture plate 40 is sized to minimally cover hole 30 in ground plane 28, and to preferably cover and extend beyond hole 30 to provide a continuous ground plane. Aperture plate 40 includes an aperture 42 therethrough, aperture 42 being aligned with hole 30. Hole 30 is sized to accommodate aperture 42. Aperture plate 40 may be etched, printed, laminated, or secured using other standard techniques onto dielectric substrate 44. Dielectric substrate 26 preferably is a relatively thick substrate with a low dielectric constant while dielectric substrate 44, on the other hand, preferably is a thinner substrate with a higher dielectric constant. For example, dielectric substrate 44 can be a glass-filled polyester printed circuit board with a dielectric constant of 4.3, plated with copper on both sides. If plated on both sides, aperture 42 in aperture plate 40 can be etched from the copper plating on dielectric substrate 44.

Referring to Figures 3 and 4, microstrip transmission line 50 can be etched from the copper plating on the side opposite aperture plate 40 on dielectric substrate 44. Aperture 42 allows for electromagnetic coupling of microstrip patch 24 to transmission line 50. Aperture 42 is preferably a rectangular slot and sized based on the physical size of microstrip patch 24 and transmission line 50, the material used for dielectric substrates 26 and 44, and the frequency of transmission. Transmission line 50 preferably has the form of an open

circuit stub, placed for optimum coupling, usually centered over the aperture, and extends approximately one-quarter of a wavelength past aperture 42. The width of transmission line 50 depends on the material used for dielectric substrate 44, as well as matching the characteristic impedance of any external electronics. Coaxial cable 52 may be connected to transmission line 50 and grounded on conductive aperture plate 40.

To protect the feed structure and any other components within interface portion 18 of sign 2, protective cover 64 surrounds the feed structure. Cover 18 may be any suitable material, such as a metal, for example aluminum, or plastic. Further, gasket 62 provides a seal between protective cover 64 and display portion 16 of sign 2. Spring 60 ensures aperture 42 is properly aligned with hole 30 in ground plane 28 and microstrip patch 24. As shown in Figure 4A, spring 60 includes ribs 66 and 66A to vertically position aperture plate 40. Further, spring 60 provides transverse pressure, that is pressure perpendicular to the ground plane, thereby securely positioning aperture plate 40 against ground plane 28. Spring 60 is preferably molded synthetic rubber, molded in a elongated "C" shape. While spring 60 is shown and described in Figures 4 and 4A, any means for securely positioning aperture plate 40 against ground plane 28 may be used.

Referring back to Figures 2A and 3, display portion 16 and interface portion 18 of modular integrated electronic sign are fastened together using any appropriate disconnectable fasteners, for example, bolts, screws, clamps, latches, locks, or rivets. When fastened together, microstrip patch 24 is electromagnetically coupled to microstrip transmission line 50. While coaxial connections are not as reliable due to breakage, the electromagnetic connection system of the present invention has a mechanically stable connection, thereby providing high reliability. Further, the connection is forgiving, as the precise alignment of the aperture and the transmission line is preassembled in the interface portion of the sign. The placement of the interface portion with respect to the display portion of the sign only requires that the aperture fits within the boundaries of the opening in the ground plane of the display portion of the sign.

Referring to Figure 5, a further advantage of the present invention will be described. Dielectric substrate 44 of interface portion 18 of modular electronic sign 2 is preferably a dual sided copper-plated glass-filled epoxy printed circuit board. Aperture 42 may be etched out of one copper-plated side of dielectric substrate 44 to create aperture plate 40. On the side of dielectric substrate 44 opposite aperture plate 40, microstrip transmission line 50 may be etched. Further, surface mounted electronic components 70 may be mounted on dielectric substrate 44 with copper electrical connections etched as necessary. Further, power source 72, such as a battery, may further be mounted on dielectric substrate to make the system completely self-contained. In such a self-contained system, no connection to external mod-

ules is necessary and coaxial cable 52 is not needed. If, however, connection to a remote power source, a central monitoring or programming station, or additional electronics are desired, coaxial cable 52 is electrically connected to transmission line 50 and electrical components 70. By mounting electrical components on dielectric substrate 44, modularity is achieved by allowing either a relatively simple interface portion to be connected to the display portion of the sign or a complex self-contained interface portion, having electronic components therein, all interface portions are easily electromagnetically connected to the display portion.

While in the aforementioned embodiment of the present invention the aperture for the aperture coupling was included in the interface portion of the sign, it is also possible to include the aperture in the display portion of the sign. In the aforementioned embodiment, the aperture and microstrip transmission line may be precisely etched into the dielectric substrate to ensure proper alignment. Referring to Figure 6, a second embodiment of the present invention is shown. Interface portion 18 includes protective cover 64, gasket 62 and spring 60, similar to the aforementioned embodiment. Dielectric substrate 80, however, is only plated on a single side. Preferably, dielectric substrate 80 is a glass-filled epoxy plated on one side with copper. Plated side 82 may be etched to include transmission line 50 as well as any electrical connections for surface mounted electrical components. Non-plated side 84, however, lies adjacent the ground plane of the display portion. Rather than having a larger hole in the ground plane, an aperture of precise proportions for electromagnetic coupling is included in the ground plane. Therefore, when non-plated side 84 lies adjacent the ground plane, the microstrip patch will be electromagnetically coupled to the microstrip transmission line 50.

Referring to Figure 7, 7A, and 7B, another form of a modular electronic sign is shown, namely in the form of an electronic license plate. Electronic license plate 100 has printed information 103 for the visual communication of information. Display portion 101 of electronic license plate 100 may include retroreflective sheeting 102 for increased optical efficiency in reading printed information 103 on license plate 100. Microstrip patch 106 is printed, etched or laminate onto dielectric substrate 108. Ground plane 110 includes hole 112, suitably sized to allow aperture 122 of interface portion 120 of electronic license plate 100 to fit within its boundaries when interface portion 120 is fastened to display portion 101. Interface portion 120 may be fastened to display portion 101 with any suitable fastener, for example, with bolts 124 such that aperture 122 is aligned with hole 112 and microstrip patch 106 and electromagnetically couples microstrip patch to transmission line 126. In yet another embodiment of the present invention, the display portion need not include a ground plane, as shown in Figures 8, 8A and 8B. Instead, conductive substrate 110 with aperture 122 is included in interface portion 120 of the

electronic license plate 100. Display portion 101 includes microstrip patch 106 and dielectric substrate 108. In such an embodiment, cover 130 protects dielectric substrate 128 with transmission line 126 mounted thereon. Further, interface portion 120 may be larger, as conductive substrate 110 must be of sufficient size to function as the ground plane for microstrip patch 106.

10 Claims

1. A modular microstrip antenna system, said system comprising:

15 a first antenna portion (16) comprising:

a radiating element (24) having a first side and a second side;
a first dielectric substrate (26) having a first side and a second side, said second side of said radiating element adjacent said first side of said first dielectric substrate; and
a first conductive substrate (28) having a first side and a second side, said second side of said dielectric substrate adjacent said first side of said first conductive substrate, said first conductive substrate having an opening (30) therethrough;

30 a second antenna portion (18) comprising:

a second conductive substrate (40) having a first side and a second side and an aperture (42) therethrough, said first side of said second conductive substrate having a surface area greater than said opening in said first conductive substrate, said aperture aligned with said radiating element;
a second dielectric substrate (44) having a first side and a second side, said second side of said second conductive substrate adjacent said first side of said second dielectric substrate; and
a transmission line (50) adjacent said second side of said second dielectric substrate; and

connection means (52) for removably connecting said first antenna portion to said second antenna portion.

2. A modular microstrip antenna system, said system comprising:

55 a first antenna portion (16) comprising:

a radiating element (24) having a first side and a second side;

a first dielectric substrate (26) having a first side and a second side, said second side of said radiating element adjacent said first side of said first dielectric substrate;
 a first conductive substrate (28) having a first side and a second side, said second side of said first dielectric substrate adjacent said first side of said first conductive substrate, said first conductive substrate having an aperture (30) therethrough, said aperture (30) aligned with said radiating element (24);

a second antenna portion (18) comprising:

a second dielectric substrate (80) having a first side (82) and a second side (84), said second side (84) of said second dielectric substrate (80) adjacent said second side of said first conductive substrate; and
 a transmission line (50) adjacent said second side of said second dielectric substrate; and

connection means (52) for removably connecting said first antenna portion to said second antenna portion.

3. A modular microstrip antenna system, said system comprising:

a first antenna portion (101) comprising:

a radiating element (106) having a first side and a second side; and
 a first dielectric substrate (108) having a first side and a second side, said second side of said radiating element adjacent said first side of said first dielectric substrate;

a second antenna portion (120) comprising:

a conductive substrate (110) having a first side and a second side and an aperture (122) therethrough, said first side of said conductive substrate having a surface area greater than said radiating element, said aperture (122) aligned with said radiating element;
 a second dielectric substrate (128) having a first side and a second side, said second side of said conductive substrate adjacent said first side of said second dielectric substrate; and
 a transmission line (126) adjacent said second side of said second dielectric substrate; and

connection means for removably connecting said first antenna portion to said second antenna portion.

4. The system according to claims 1, 2 or 3, wherein said second antenna portion (18, 120) further comprises a protective cover.
5. The system according to claim 4, wherein said second antenna portion (18, 120) further comprises securing means for positionally securing said second dielectric substrate (44, 80, 128) within said protective cover and for securing said first side of said second conductive substrate to said second side of said first conductive substrate.
6. The system according to any of claims 1 to 5, wherein said second antenna portion (18, 120) further comprises a coaxial cable (52) connected to said transmission line (50).
7. The system according to any of claims 1 to 6, wherein said second antenna portion (18, 120) further comprises electronic means.
8. The modular antenna system according to claim 7, wherein said second dielectric substrate (44, 80, 128) is a printed circuit board, and wherein said electronic means is mounted on said printed circuit board.
9. The system according to any of claims 1 to 8, wherein the first antenna portion further includes retroreflecting means (22, 102) for retroreflecting incident light, said retroreflecting means having printed information thereon for visual communication of information.

40 Patentansprüche

1. Modulares Mikrostrip-Antennensystem, wobei dieses System aufweist:

einen ersten Antennenteil (16), der aufweist:

ein Strahlungselement (24) mit einer ersten Seite und einer zweiten Seite;
 ein erstes dielektrisches Substrat (26) mit einer ersten Seite und einer zweiten Seite, wobei die zweite Seite des Strahlungselements benachbart zur ersten Seite des ersten dielektrischen Substrats ist; und
 ein erstes leitendes Substrat (28) mit einer ersten Seite und einer zweiten Seite, wobei die zweite Seite des dielektrischen Substrats benachbart zur ersten Seite des ersten leitenden Substrats ist, wobei das er-

ste leitende Substrat eine Öffnung (30) hindurch hat;

einen zweiten Antennenteil (18), der aufweist:

ein zweites leitendes Substrat (40) mit einer ersten Seite und einer zweiten Seite und einer Apertur (42) hindurch, wobei die erste Seite des zweiten leitenden Substrats einen Oberflächenbereich hat, der größer als die genannte Öffnung in dem ersten leitenden Substrat ist, wobei die Apertur mit dem Strahlungselement ausgerichtet ist;

ein zweites dielektrisches Substrat (44) mit einer ersten Seite und einer zweiten Seite, wobei die zweite Seite des zweiten leitenden Substrats benachbart zur ersten Seite des zweiten dielektrischen Substrats ist; und

eine Übertragungsleitung (50), die zur zweiten Seite des zweiten dielektrischen Substrats benachbart ist; und

eine Verbindungseinrichtung (52), um den ersten Antennenteil abnehmbar mit dem zweiten Antennenteil zu verbinden.

2. Modulares Mikrostrip-Antennensystem, wobei dieses System aufweist:

einen ersten Antennenteil (16), der aufweist:

ein Strahlungselement (24) mit einer ersten Seite und einer zweiten Seite;

ein erstes dielektrisches Substrat (26) mit einer ersten Seite und einer zweiten Seite, wobei die zweite Seite des Strahlungselements benachbart zur ersten Seite des ersten dielektrischen Substrats ist;

ein erstes leitendes Substrat (28) mit einer ersten Seite und einer zweiten Seite, wobei die zweite Seite des ersten dielektrischen Substrats benachbart zur ersten Seite des ersten leitenden Substrats ist, wobei das erste leitende Substrat eine Apertur (30) hindurch hat, wobei die Apertur (30) mit dem Strahlungselement (24) ausgerichtet ist;

einen zweiten Antennenteil (18), der aufweist:

ein zweites dielektrisches Substrat (80) mit einer ersten Seite (82) und einer zweiten Seite (84), wobei die zweite Seite (84) des zweiten dielektrischen Substrats (80) benachbart zur zweiten Seite des ersten leitenden Substrats ist; und

eine Übertragungsleitung (50), die zur

zweiten Seite des zweiten dielektrischen Substrats benachbart ist; und eine Verbindungseinrichtung (52), um den ersten Antennenteil abnehmbar mit dem zweiten Antennenteil zu verbinden.

3. Modulares Mikrostrip-Antennensystem, wobei dieses System aufweist:

einen ersten Antennenteil (101), der aufweist:

ein Strahlungselement (106) mit einer ersten Seite und einer zweiten Seite; und ein erstes dielektrisches Substrat (108) mit einer ersten Seite und einer zweiten Seite, wobei die zweite Seite des Strahlungselements benachbart zur ersten Seite des ersten dielektrischen Substrats ist;

einen zweiten Antennenteil (120), der aufweist:

ein leitendes Substrat (110) mit einer ersten Seite und einer zweiten Seite und einer Apertur (122) hindurch, wobei die erste Seite des leitenden Substrats einen Oberflächenbereich hat, der größer als das Strahlungselement ist, wobei die Apertur (122) mit dem Strahlungselement ausgerichtet ist;

ein zweites dielektrisches Substrat (128) mit einer ersten Seite und einer zweiten Seite, wobei die zweite Seite des leitenden Substrats benachbart zur ersten Seite des zweiten dielektrischen Substrats ist; und eine Übertragungsleitung (126), die zur zweiten Seite des zweiten dielektrischen Substrats benachbart ist; und eine Verbindungseinrichtung, um den ersten Antennenteil abnehmbar mit dem zweiten Antennenteil zu verbinden.

4. System nach den Ansprüchen 1, 2 oder 3, wobei der zweite Antennenteil (18, 120) ferner eine Schutzabdeckung aufweist.

5. System nach Anspruch 4, wobei der zweite Antennenteil (18, 120) ferner eine Befestigungseinrichtung aufweist, um das zweite dielektrische Substrat (44, 80, 128) in seiner Lage in der Schutzabdeckung zu befestigen und um die erste Seite des zweiten leitenden Substrats an der zweiten Seite des ersten leitenden Substrats zu befestigen.

6. System nach einem der Ansprüche 1 bis 5, wobei der zweite Antennenteil (18, 120) ferner ein mit der Übertragungsleitung (50) verbundenes Koaxialkabel (52) aufweist.

7. System nach einem der Ansprüche 1 bis 6, wobei der zweite Antennenteil (18, 120) ferner eine elektronische Einrichtung aufweist.
8. Modulares Antennensystem nach Anspruch 7, wobei das zweite dielektrische Substrat (44, 80, 128) eine Leiterplatte ist und wobei die elektronische Einrichtung auf die Leiterplatte montiert ist. 5
9. System nach einem der Ansprüche 1 bis 8, wobei der erste Antennenteil ferner eine rückstrahlende Einrichtung (22, 102) aufweist, um einfallendes Licht zurückzustrahlen, wobei die rückstrahlende Einrichtung gedruckte Informationen zur visuellen Übermittlung von Information darauf hat. 10 15

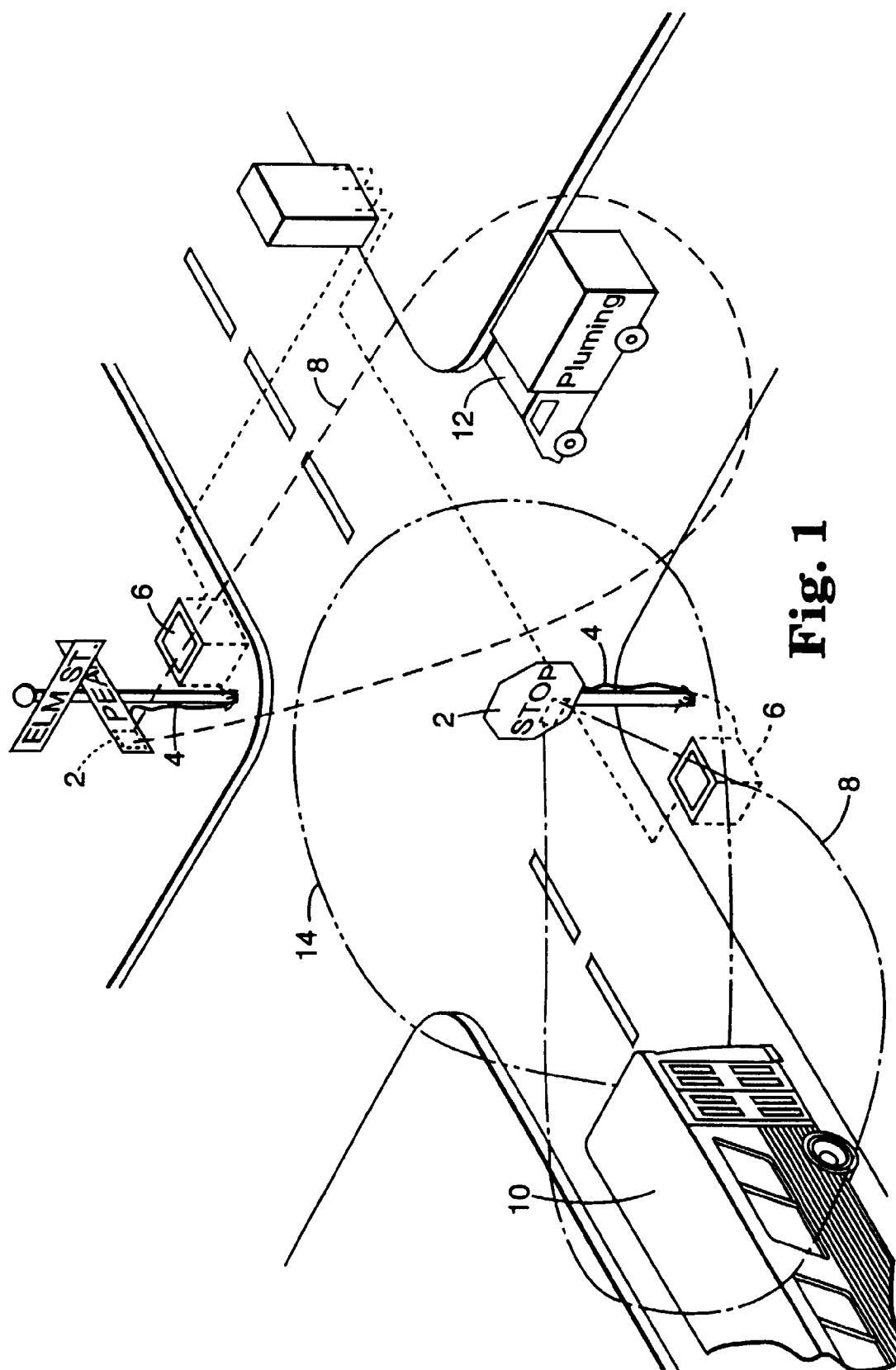
Revendications

1. Système d'antenne à microruban modulaire, ledit système comprenant: 20
- une première portion d'antenne (16) comprenant: 25
 - un élément rayonnant (24) ayant un premier côté et un deuxième côté;
 - un premier substrat diélectrique (26) ayant un premier côté et un deuxième côté, ledit deuxième côté dudit élément rayonnant adjacent audit premier côté dudit premier substrat diélectrique; et 30
 - un premier substrat conducteur (28) ayant un premier côté et un deuxième côté, ledit deuxième côté dudit substrat diélectrique étant adjacent audit premier côté dudit premier substrat conducteur, ledit premier substrat conducteur ayant une ouverture (30) le traversant; 35 40
 - une deuxième portion d'antenne (18) comprenant: 45
 - un deuxième substrat conducteur (40) ayant un premier côté et un deuxième côté et une ouverture (42) le traversant, ledit premier côté dudit deuxième substrat conducteur ayant une aire supérieure à celle de ladite ouverture dans ledit premier substrat conducteur, ladite ouverture étant alignée avec ledit élément rayonnant; 50
 - un deuxième substrat diélectrique (44) ayant un premier côté et un deuxième côté, ledit deuxième côté dudit deuxième substrat conducteur étant adjacent audit premier côté dudit deuxième substrat diélectrique; et 55
 - une ligne de transmission (50) adjacente
- audit deuxième côté dudit deuxième substrat diélectrique; et
- un moyen de connexion (52) pour relier de façon amovible ladite première portion d'antenne à ladite deuxième portion d'antenne.
2. Système d'antenne à microruban modulaire, ledit système comprenant:
- une première portion d'antenne (16) comprenant:
 - un élément rayonnant (24) ayant un premier côté et un deuxième côté;
 - un premier substrat diélectrique (26) ayant un premier côté et un deuxième côté, ledit deuxième côté dudit élément rayonnant étant adjacent audit premier côté dudit premier substrat diélectrique;
 - un premier substrat conducteur (28) ayant un premier côté et un deuxième côté, ledit deuxième côté dudit premier substrat diélectrique étant adjacent audit premier côté dudit premier substrat conducteur, ledit premier substrat conducteur ayant une ouverture (30) le traversant, ladite ouverture (30) étant alignée avec ledit élément rayonnant (24);
 - une deuxième portion d'antenne (18) comprenant:
 - un deuxième substrat diélectrique (80) ayant un premier côté (82) et un deuxième côté (84), ledit deuxième côté (84) dudit deuxième substrat diélectrique (80) étant adjacent audit deuxième côté dudit premier substrat conducteur; et
 - une ligne de transmission (50) adjacente audit deuxième côté dudit deuxième substrat diélectrique; et
 - un moyen de connexion (52) pour relier de façon amovible ladite première portion d'antenne à ladite deuxième portion d'antenne.
3. Système d'antenne à microruban modulaire, ledit système comprenant:
- une première portion d'antenne (101) comprenant:
 - un élément rayonnant (106) ayant un premier côté et un deuxième côté; et
 - un premier substrat diélectrique (108) ayant un premier côté et un deuxième côté, ledit deuxième côté dudit élément rayon-

nant étant adjacent audit premier côté dudit premier substrat diélectrique;

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- une deuxième portion d'antenne (120) comprenant: 5
 - un substrat conducteur (110) ayant un premier côté et un deuxième côté et une ouverture (122) le traversant, ledit premier côté dudit substrat conducteur ayant une aire supérieure à celle dudit élément rayonnant, ladite ouverture (122) étant alignée avec ledit élément rayonnant; 10
 - un deuxième substrat diélectrique (128) ayant un premier côté et un deuxième côté, ledit deuxième côté dudit substrat conducteur étant adjacent audit premier côté dudit deuxième substrat diélectrique; et 15
 - une ligne de transmission (126) adjacente audit deuxième côté dudit deuxième substrat diélectrique; et 20
 - un moyen de connexion pour relier de façon amovible ladite première portion d'antenne à ladite deuxième portion d'antenne. 25
- 4. Système selon les revendications 1, 2 ou 3, dans lequel ladite deuxième portion d'antenne (18, 120) comprend de plus un cache protecteur.
- 5. Système selon la revendication 4, dans lequel ladite deuxième portion d'antenne (18, 120) comprend de plus un moyen de fixation pour fixer en position ledit deuxième substrat diélectrique (44, 80, 128) dans ledit cache protecteur et pour fixer ledit premier côté dudit deuxième substrat conducteur audit deuxième côté dudit premier substrat conducteur. 30 35
- 6. Système selon l'une quelconque des revendications 1 à 5, dans lequel ladite deuxième portion d'antenne (18, 120) comprend de plus un câble coaxial (52) relié à ladite ligne de transmission (50). 40
- 7. Système selon l'une quelconque des revendications 1 à 6, dans lequel ladite deuxième portion d'antenne (18, 120) comprend de plus un moyen électronique. 45
- 8. Système d'antenne modulaire selon la revendication 7, dans lequel ledit deuxième substrat diélectrique (44, 80, 128) est une carte de circuit imprimé, et dans lequel ledit moyen électronique est monté sur ladite carte de circuit imprimé. 50
- 9. Système selon l'une quelconque des revendications 1 à 8, dans lequel la première portion d'antenne inclut de plus un moyen rétro-réfléchissant (22, 102) pour rétro-réfléchir la lumière incidente, ledit moyen rétro-réfléchissant ayant une information 55



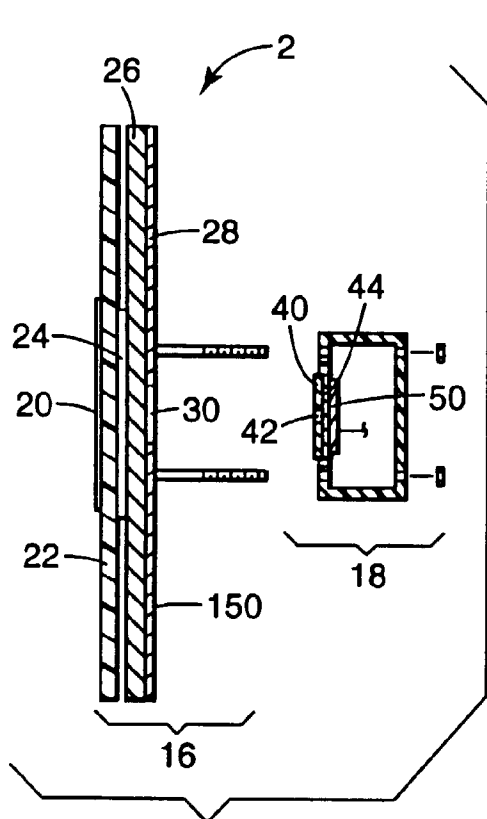


Fig. 2A

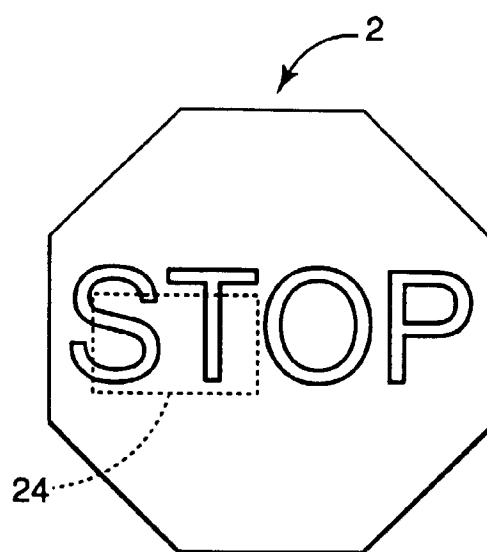


Fig. 2

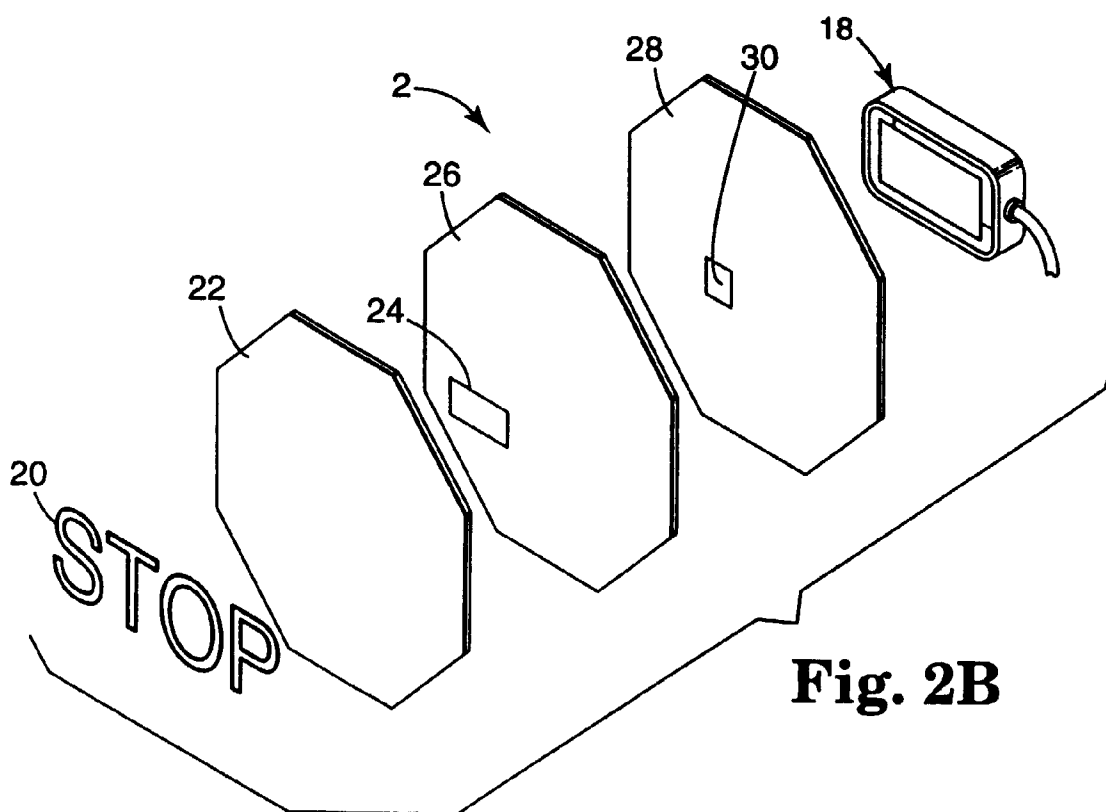


Fig. 2B

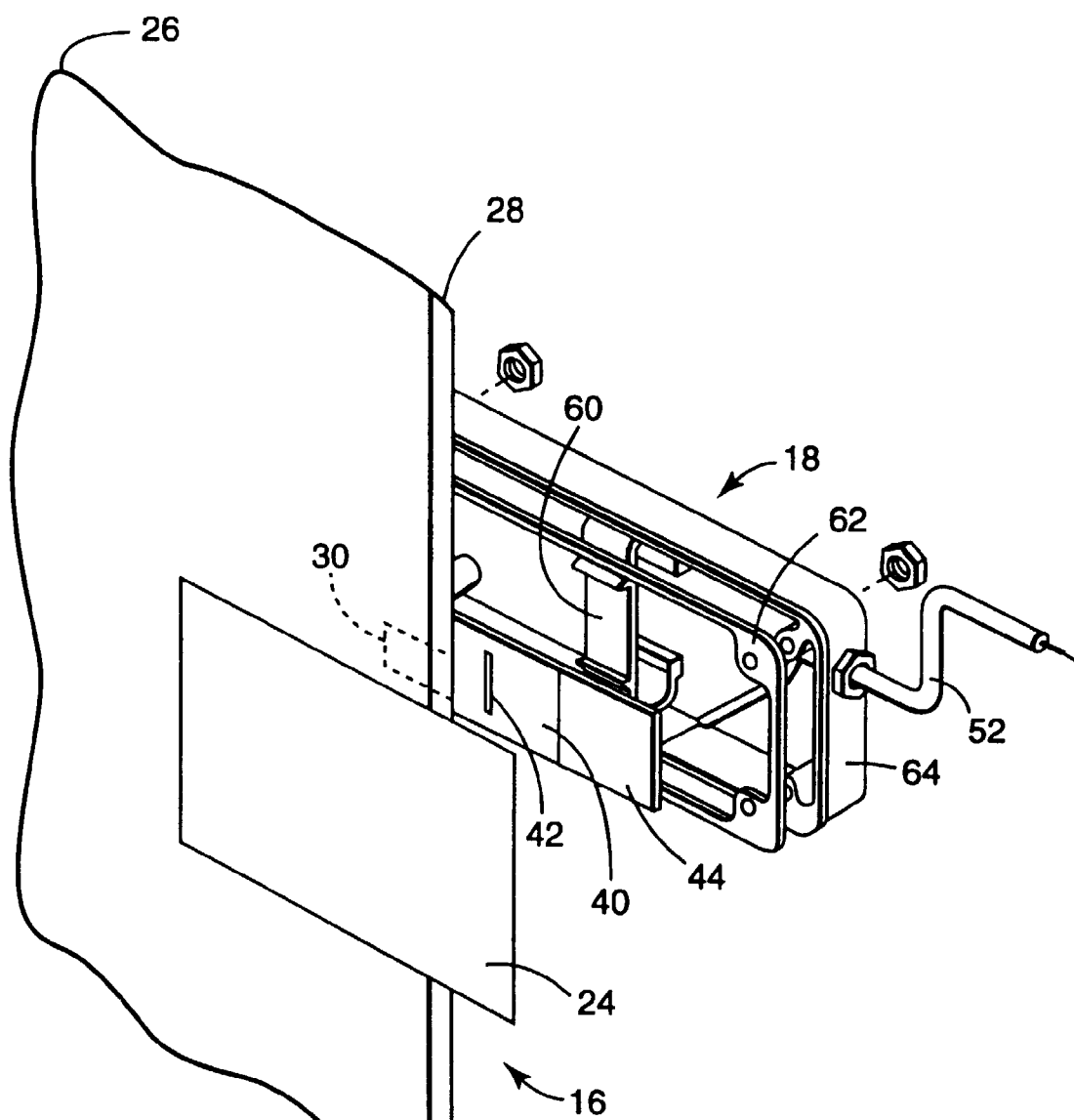


Fig. 3

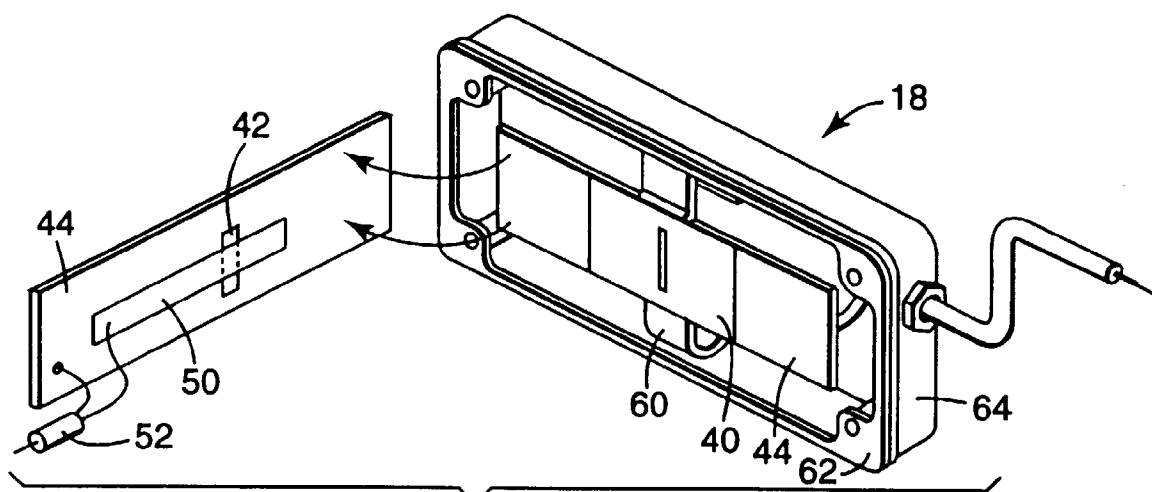


Fig. 4

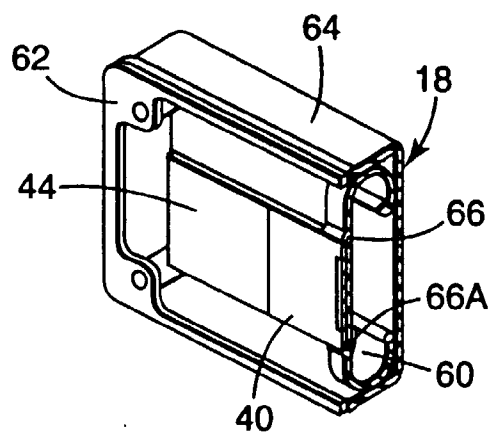


Fig. 4A

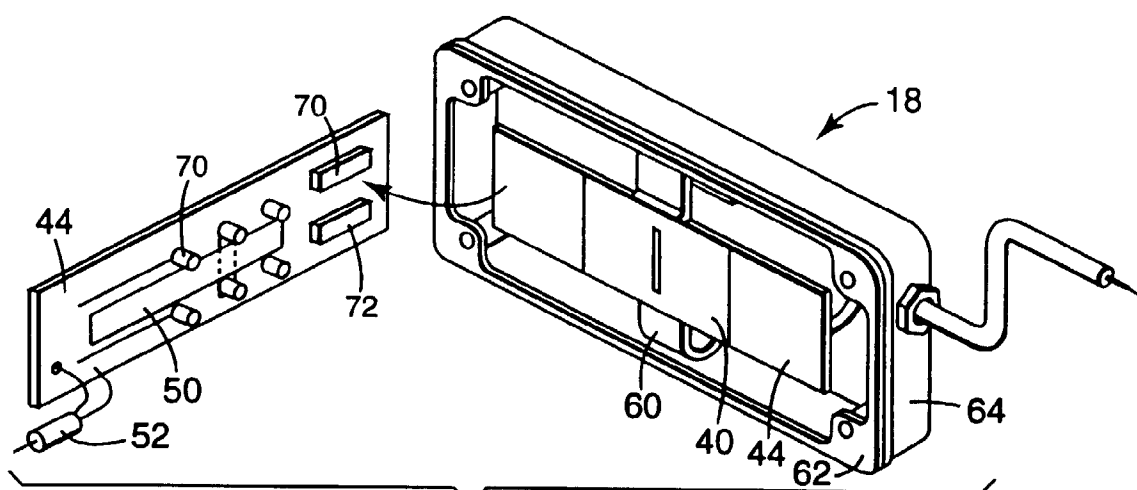


Fig. 5

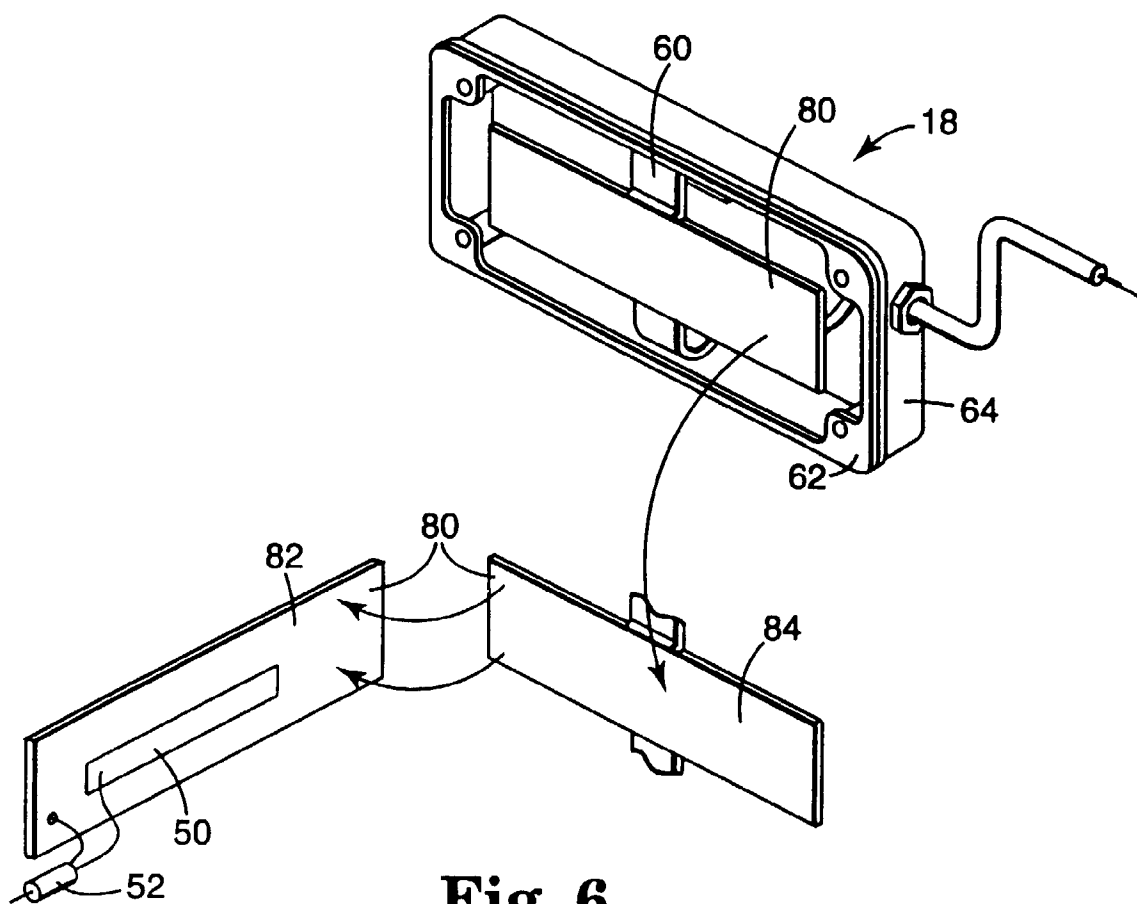


Fig. 6

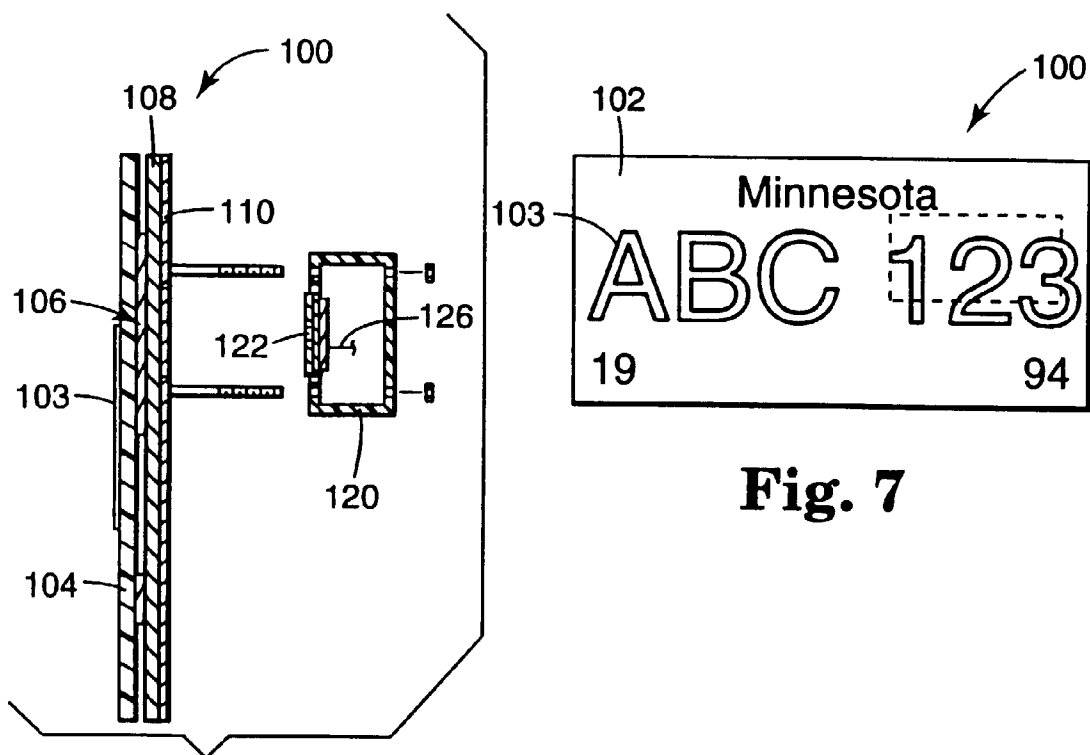


Fig. 7

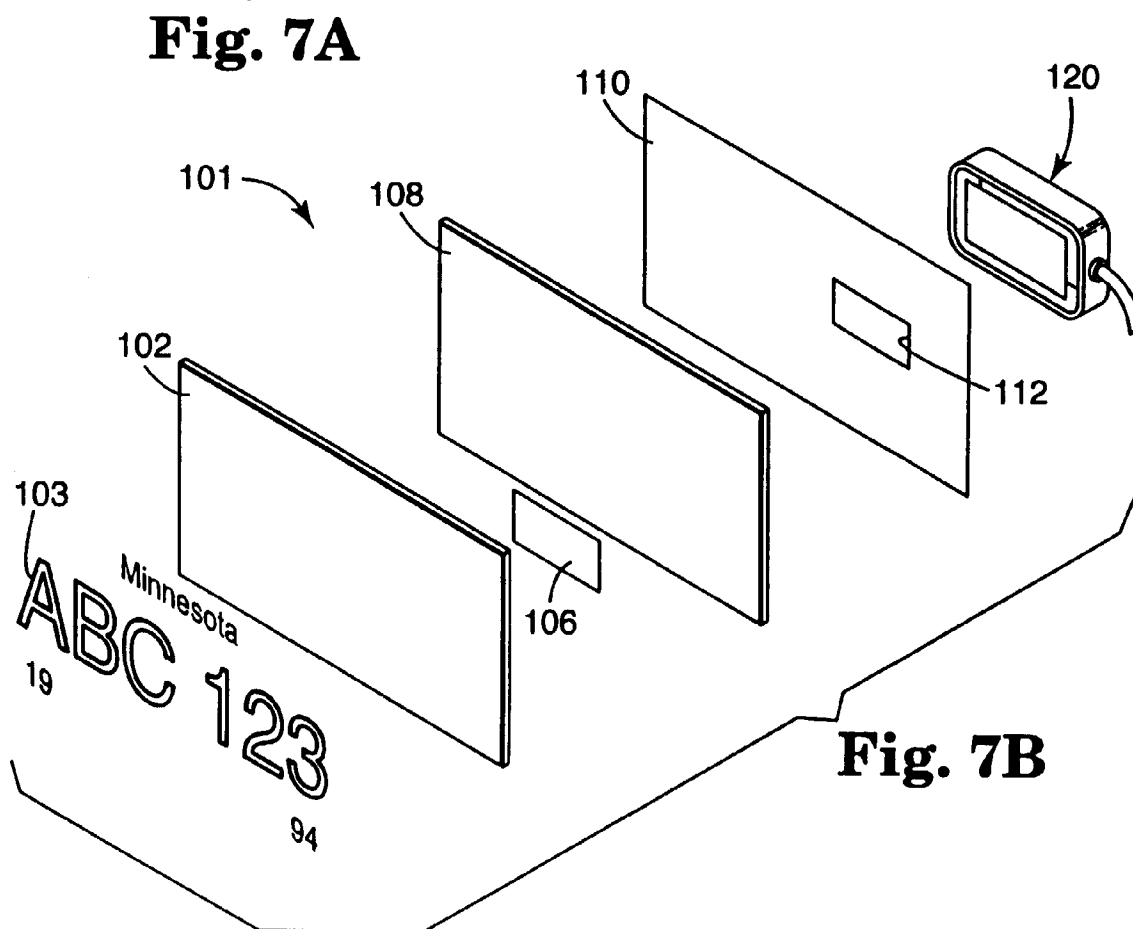


Fig. 7B

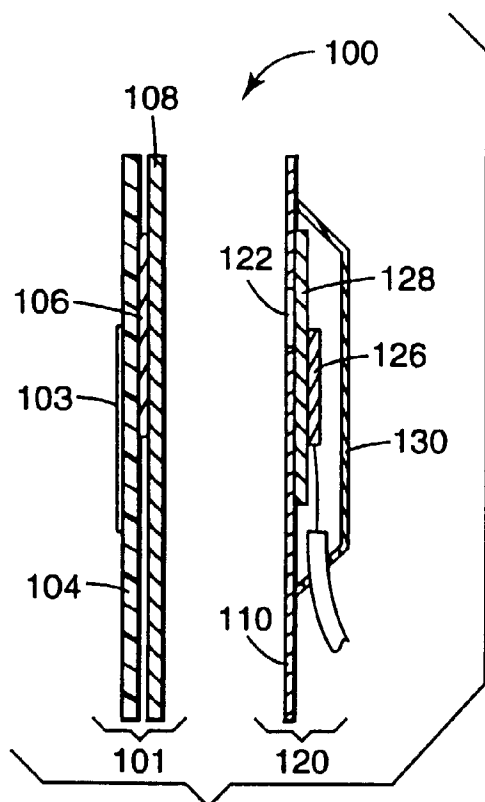


Fig. 8A

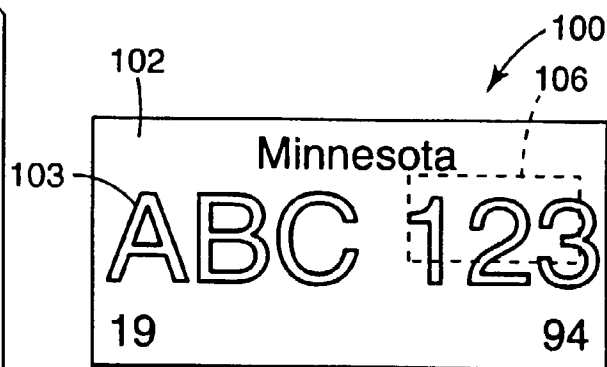


Fig. 8

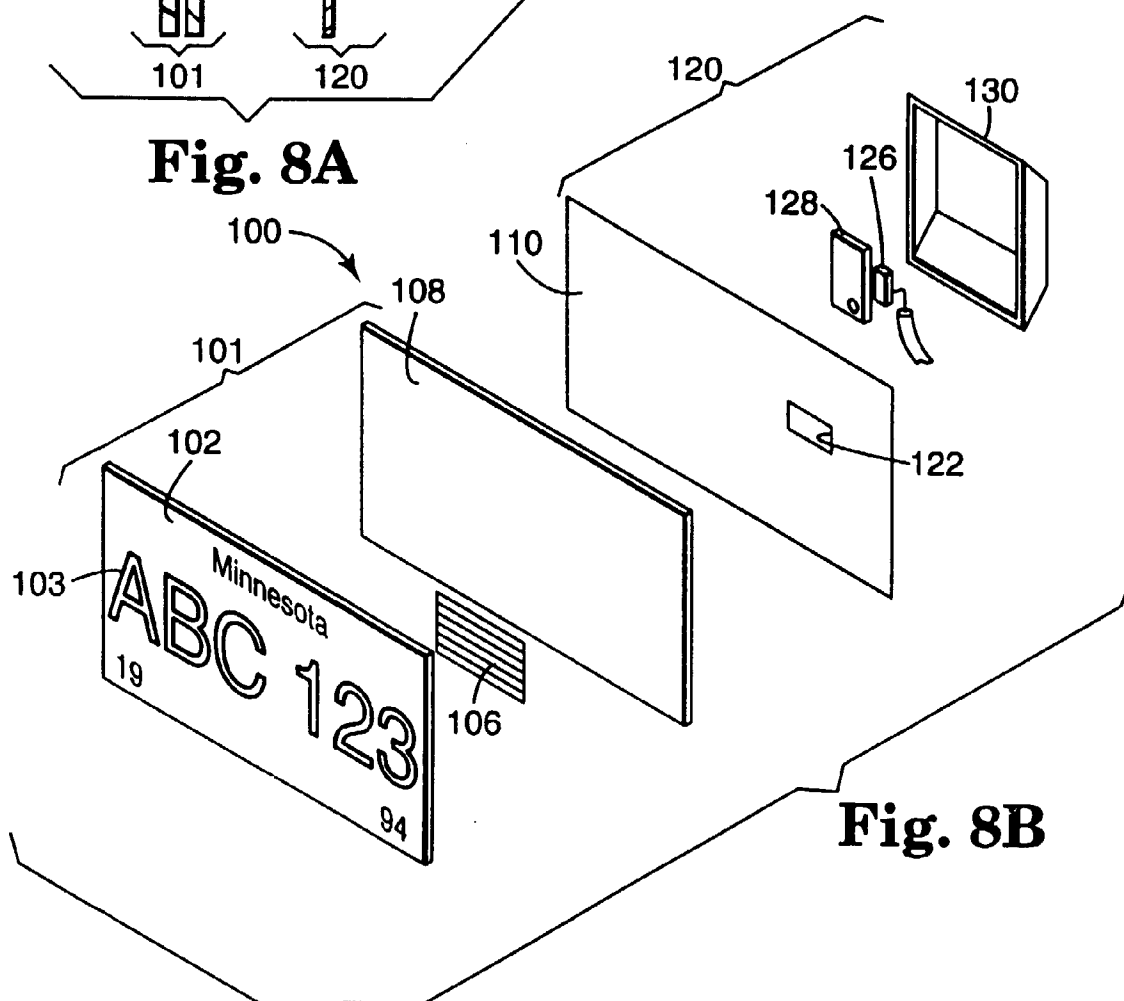


Fig. 8B