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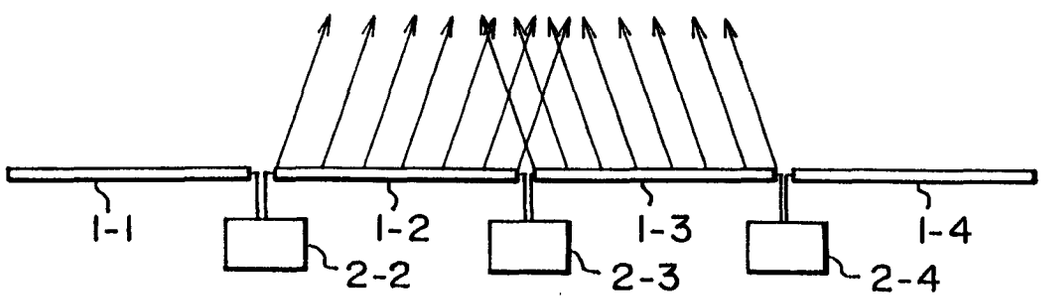
## (54) Leaky cable feeding system

(57) The present invention provides a communication system for transacting information with moving bodies by using a leaky cable (1) as an aerial cable. In this communication system, communication units (2) are provided at both ends of the leaky cable (1) for feeding power from both ends of the leaky cable so that a communication disabled area (21) never occurs and the reliability as a communication system is very high.

FIG. 3

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## Description

**[0001]** The present invention relates to a feeding system for a leaky communication cable used for communications using high frequency signals, such as microwave signals.

**[0002]** Leaky cables are used for communications with moving bodies such as communications with a train, or communications with a vehicle running in a tunnel. There are two kinds of supply or feeding system for supplying power to a leaky line; one is a one-way system in which a leaky cable 11 is uni-directionally located only on one side of a communication unit 12 as shown in Fig. 5; the other is a two-way location system in which the leaky cable 11 is bidirectionally located on both sides of a communication unit 12 as shown in Fig. 6.

**[0003]** In these systems the direction of radio wave emission is determined by a gap between leaky holes located on the leaky cable 11. Assuming that the emitting direction is $\theta$ and the gap between the leaky holes is P/2, a relationship between the gap between leaky holes P/2 and the emitting direction $\theta$ is expressed by the following expression:-

$$\theta = \sin^{-1}\left(\frac{n\lambda}{P} + \frac{1}{\nu}\right) \quad (1)$$

where $n = 0, +1, \pm 2 \ldots \ldots, \nu$ indicates compression rate of a wavelength, and $\lambda$ is the wavelength.

**[0004]** Generally an angle close to the vertical direction is selected as the emitting direction $\theta$. However, if the angle of emitting direction $\theta$ is actually vertical, propagation loss in the leaky cable becomes very large due to resonance, which disables communication. It is therefore required to emit a radio wave 20 in a diagonal direction slightly deviated from the vertical direction as shown in Fig. 7.

**[0005]** However, the deviation may become very large at some frequencies. In the bidirectional location system as shown in Fig. 6, there is the problem that a communication disabled area 21, as shown in Fig. 8, in which radio waves do not reach occurs. When used for important communications, failure of communication equipment causes a severe trouble, and to evade the trouble, it is required to improve reliability of a communication system.

**[0006]** Objects of the present invention are to solve the problems of a feeding system for a leaky cable based on conventional technology, to provide a feeding system for a leaky cable not generating a communication disabled area in which radio waves do not reach and at the same time to provide a communication system having high reliability.

**[0007]** To achieve the objects described above, the present invention provides a feeding system for a leaky cable having communication units provided at both ends of the leaky cable for enabling feeding from either end of the leaky cable of a communication system for information transaction with moving bodies by using the leaky cable as an aerial cable.

**[0008]** With the feeding system for a leaky cable according to the present invention, it is possible to eliminate areas where radio waves do not reach, and even when one of the two communication units fails, the other one is normally working, so that probability of communication failure becomes smaller.

**[0009]** Preferred embodiments of the present invention will now be described with reference to the accompanying drawings, in which:-

Fig. 1 is a block diagram showing Embodiment 1 of the present invention;
Fig. 2 is an explanatory view showing an example of operations in the Embodiment above;
Fig. 3 is an explanatory view showing an example of actual operations in the Embodiment above;
Fig. 4 is a block diagram showing Embodiment 2 of the present invention;
Fig. 5 is a block diagram showing configuration of a feeding system for a leaky cable based on the conventional technology but belonging to the same type as the present invention;
Fig. 6 is a block diagram showing another example of a feeding system for a leaky cable based on the conventional technology and belonging to the same type as the present invention;
Fig. 7 is an imaginative view showing an emitting direction of a radio wave; and
Fig. 8 is an explanatory view showing a situation in which a communication disabled area has occurred due to a leaky cable based on the conventional technology.

**[0010]** In Embodiment 1 of the present invention, shown in Fig. 1 to Fig. 3, communication units 2-1 to 2-5 are located at both sides of leaky cables 1-1 to 1-4, and power is fed to both ends of each of the leaky cables 1-1 to 1-4 respectively. Although four leaky cables and five communication units are provided in this example, there is no restriction to these numbers. In this Embodiment, if the communication unit 2-3 is not provided and only the communication unit 2-2 and the communication unit 2-4 are operating on leaky cables 1-2 and 1-3, a communication disabled area 21 as shown in Fig. 2 occurs similarly to the case of the conventional type of bidirectional location system shown in Fig. 6.

**[0011]** However, in this Embodiment of the invention, the communication unit 2-3 is provided between the communication unit 2-2 and the communication unit 2-4 as shown in Fig. 3. The communication disabled area 21 therefore falls in a communication range of the communication unit 2-3, so that generation of the communication disabled area 21 as described above is prevented. Furthermore, in this Embodiment, by using the system described above, when a communication unit 2 fails, communications can be continuously performed

by another communication unit 2 connected to the other end of the leaky cable 1 to which the failed communication unit 2 is connected, and because of this configuration, it never occurs that the communication state is completely disabled.

**[0012]** In Embodiment 2 of the present invention shown in Fig. 4, each pair of communication units 3-1, 3-2; 3-3, 3-4; 3-5, 3-6; 3-7, 3-8 is provided in both sides of each of leaky cables 1-1, 1-2, 1-3, 1-4 respectively, and power is fed to both ends of each of the leaky cables 1-1 to 1-4. As a result, this Embodiment is different from Embodiment 1 only in that the communication units 3 feed power not to two leaky cables 1 at both sides but to one leaky cable 1, and is the same as Embodiment 1 in all other respects. It should be noted that, also in this Embodiment, the number of cables 1 and a number of communication units 3 are not limited to those shown in the figure.

**[0013]** As described above, the present invention provides a communication system for transacting information with moving bodies by using a leaky cable 1 as an aerial cable, and in this communication system, communication units 2, 3 are provided at both ends of a leaky cable 1 for feeding power from both ends of the leaky cable 1, and because of this configuration, a communication disabled area 21 generated according to a direction in which a radio wave is emitted never occurs, and even if one of the communication units 2, 3 fails, another communication unit 2, 3 will generally work normally, which provides the advantage that probability of communication failure is reduced.

## Claims

1. A power feeding system for a leaky cable (1) used in a communication system for transacting information with moving bodies by using a leaky cable (1) as an aerial cable;

   wherein a communication unit (2) is located at both edges of the leaky cable (1) and power is fed from both ends of the leaky cable (1).

FIG. 1

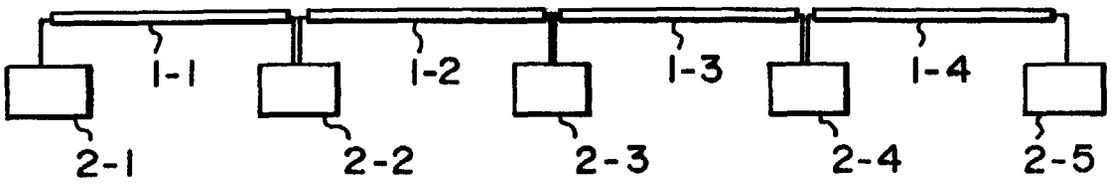


FIG. 2

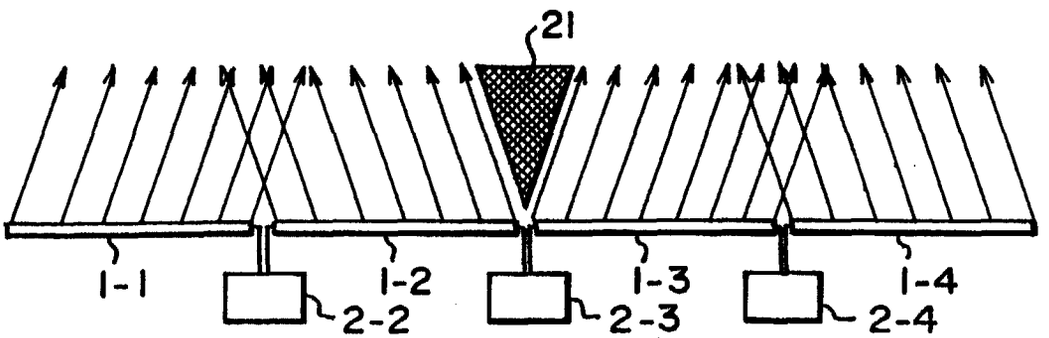


FIG. 3

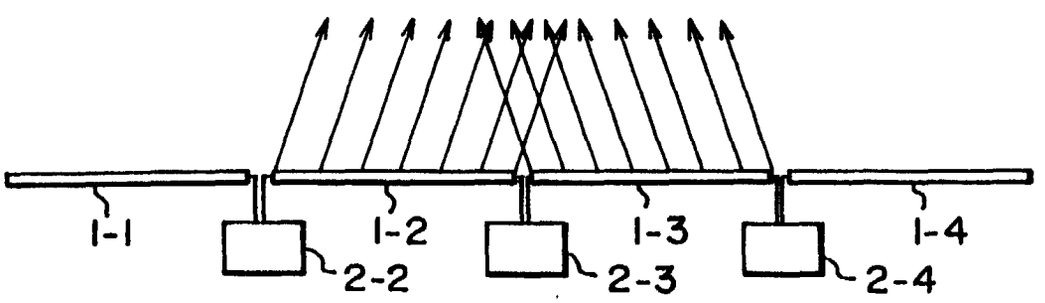

FIG. 4

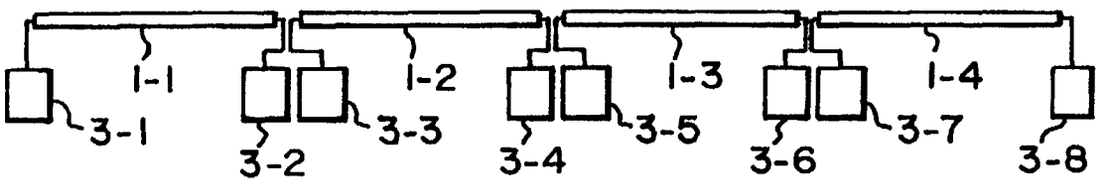


FIG. 5

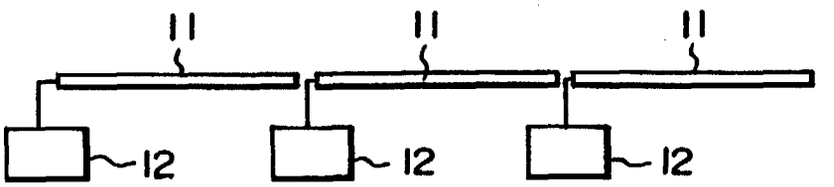


FIG. 6

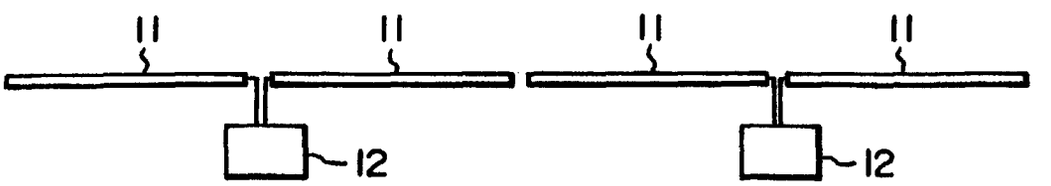

FIG. 7

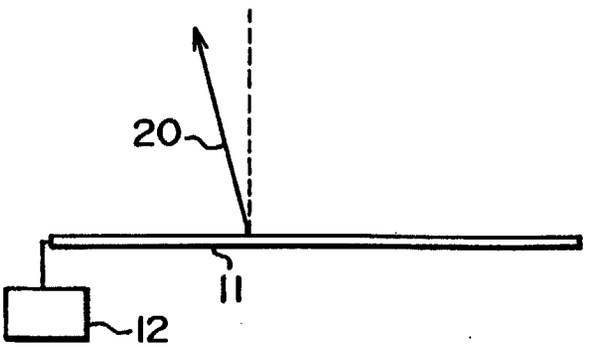


FIG. 8