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TITLE OF INVENTION	
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54	MOBILE RADIO STATION AND HYBRID CABLE FOR A MOBILE RADIO STATION
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EARLIEST PRIORITY CLAIMED		COUNTRY	NUMBER	DATE
NB - Use International abbreviation for country (See Schedule 4)		33 DE	31 10 2008 010 929.0-34	32 25 Feb 2008

57	Abstract (not more than 150 words) and figure of the drawings to which the abstract refers, are attached.
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Number of sheets	12
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Abstract

5 A hybrid cable is proposed that includes a coaxial cable (201) with an outer conductor (204) and a hollow inner conductor (202) that encloses an inner space. A data line (108) is arranged in an inner space of the inner conductor (202).

Figure for publication: Figure 3



2009/01312

Mobile radio station and hybrid cable for a mobile radio station**Field of the invention**

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This invention relates to cables for transmitting electrical and optical signals, especially with coaxial cables. The invention relates to a hybrid cable. The hybrid cable is especially well-suited for use in a mobile radio station.

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Background to the invention

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In contrast to mobile radio stations used up until now, so-called Remote Radio Head (RRH) stations have the advantage that a lower transmission capacity is needed since the high-frequency transmitter is situated much closer to the antenna and consequently only a shorter high-frequency line to the antenna is needed. This fact increases the efficiency of the mobile radio station substantially. Moreover, the transmitter mast of an RRH station can be installed up to several hundred meters away from the base station.

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The term remote radio head is used in mobile radio technology to refer to the outdoor and weather-proof installation of the power supply, the transmitter and receiver module, the output amplifier and the filters on the antennas. The communication with the base station is usually effectuated via a fiberglass connection.

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Up until now, the structure of RRH mobile radio stations with remote high-frequency transmitters has been expensive in comparison to conventionally constructed mobile radio systems since a power supply line and a data

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line had to be installed. So far, this is only cost-effective in the case of fairly long cables. However, an RRH mobile radio system entails considerable cost advantages in comparison to a conventionally constructed mobile radio system during ongoing operation.

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In the state of the art, cables are known in which several types of conductors are combined in order to lower installation costs or in cases where exceptional difficulties have to be overcome.

- 10 German Utility Model DE 20 2007010626 U1 discloses a data-energy hybrid line. This hybrid line is intended for applications in high-frequency shielded areas and it combines electrically shielded direct voltage lines with potential-free optical fibers in one cable. U.S. Pat. Appl. 2003/0121694 A1 discloses a cable in which a power line, a data line and
15 a control line are combined into a single cable having a shared sheathing.

The cables known from the state of the art, however, are not suitable for facilitating the conversion of existing mobile radio stations to modern RRH technology.

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Accordingly, a need exists for lowering the point at which RRH mobile radio systems become cost-effective.

- A further need exists for creating an RRH mobile radio system that is more
25 cost-effective than known RRH mobile radio systems.

Summary of the Invention

- The invention provides a hybrid cable including a coaxial cable with
30 an outer conductor and a hollow inner conductor that encloses an inner

space, wherein a data line is arranged in the inner space of the inner conductor.

In an embodiment of the invention, the data line is configured as an optical
5 and/or electrical data line.

According to a further aspect of the invention, there is provided a mobile radio system including a hybrid cable as described above.

10 Finally, the invention proposes a method for the installation and production of a hybrid cable.

The method according to the invention includes at least the following steps:-

- 15 – introduction of a data line into an inner space of a hollow inner conductor of a coaxial cable; and
- connecting the inner conductor and an outer conductor to a power supply.

20 **Detailed Description of the Invention**

The above-mentioned and additional advantages, special aspects and practical refinements of the invention are elucidated on the basis of the following non-limiting embodiment which will be described below with
25 reference to the figures.

The figures show the following:

Figure 1 a schematic depiction of an RRH mobile radio system;
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Figure 2 a schematic and perspective cross sectional view of a hybrid cable according to the invention; and

5 Figure 3 a process step for the production of a hybrid cable according to the invention, in a schematic depiction.

Figure 1 schematically shows a mobile radio system that is installed in a tall building 101. On the roof 102 of the building 101, there is a mast 103 on which several antennas 104 are installed. A high-frequency transmitter 105 is installed on the mast 103 in the immediate vicinity of the antennas 104. The high-frequency transmitter 105 is also referred to as a remote radio head (RRH) 105. A power supply 106 for the system is installed in the lower section of the building 101, for example, in the basement or on the ground floor. A so-called base station 107 with a radio server is accommodated along with the power supply 106. As far as the signals are concerned, the base station 107 is connected to the RRH 105 via a data line 108 for purposes of data exchange. Typically, the data line 108 is an optical data cable for transmitting optical data. Moreover, a power line 109 leads from the power supply 106 to the RRH 105. The power line 109 is typically a 48-volt current connection. In the conventional manner, a fuse box 110 is installed between the power supply 106 and the RRH 105.

As an alternative to the embodiment of the mobile radio system shown in Figure 1, the mobile radio system can also be installed in a tower or on a tall mast.

In contrast to the mobile radio station shown in Figure 1, conventional mobile radio systems that are not equipped with an RRH 105 have the high-frequency transmitter in the lower section of the building or at the foot of a mast on which the antennas 104 of the mobile radio system are

arranged. In the conventional mobile radio systems, the high-frequency transmitter is only connected to the antennas via coaxial cables.

Consequently, when it comes to RRH mobile radio systems, in addition to the coaxial cables that have been installed until now in mobile radio sites, additional optical cables have to be installed for the construction of mobile radio systems of the new generation. Moreover, a 48-volt power connection has to be installed in order to supply the remote radio heads that are near the antennas.

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Up until now, when a new mobile radio system was built or when an existing one was modernized, there was a need to install a separate data line as well as a cable for supplying power to the RRH. As a result, costly work has to be carried out on the cable routes, especially in terms of fire protection, the wall openings have to be enlarged, etc., so that today, RRH systems are only cost-effective in the case of fairly long cables.

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This is where the invention endeavors to provide a remedy. The invention proposes using the coaxial cable that is already present in a manner as well that is both different and new.

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Figure 2 shows a coaxial cable 201 of the type known from the state of the art. From the inside to the outside, the coaxial cable 201 has an inner conductor 202 made of copper, which is configured to be hollow and which encloses a space. The inner conductor 202 is surrounded by a dielectric 203. The dielectric 203 is surrounded by an outer conductor 204, which is insulated by a protective jacket 205 and protected against external damage.

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- In conventional mobile radio systems, the high-frequency cable that connects the high-frequency transmitter to the antennas has a hollow copper inner conductor when its diameter is more than $\frac{7}{8}$ " (2.2 cm). The invention proposes installing the data line 108 in the hollow inner conductor 202 of the coaxial cable 201. Thus, the antenna cable 201, which has already been installed in the mobile radio system, is used, in a manner of speaking, as an empty conduit for installing the data line 108 needed for the RRH 205.
- 10 This approach for converting already existing mobile radio stations to the new RRH technology has a number of advantages. These include especially a simplified installation and thus the possibility to cut costs, since no new cable routes have to be built. For example, it is avoided that new wall openings have to be created. Moreover, the additional data line 108 does not have to be tied in place. Furthermore, no additional measures have to be carried out in terms of fire protection. After all, the sensitive data lines 108 inside the coaxial cable 201 are very well-protected against external influences, for example, also against attack by rodents.
- 15
- 20 The coaxial cable 201 can also be used as a power cable 109 for the 48-volt power supply of the RRH 105 in that the inner conductor 202 and the outer conductor 204 are connected to the appropriate terminals of the power supply 106 and of the RRH 105.
- 25 Figure 3 illustrates how a data cable 108 is pulled into a coaxial cable 201. Completely analogously as with a conventional empty conduit installation, a tube spiral 301, for example, is used to pull the data line 108 into the hollow space of the inner conductor 202.

Thanks to the proposed utilization of the already installed coaxial cable 201 for the power supply, existing mobile radio stations can be converted to the new RRH technology much less expensively.

- 5 It is to be appreciated, that the invention is not limited to any particular embodiment or configuration as hereinbefore generally described or illustrated.

10 The claims which follow are to be considered an integral part of the present disclosure. Reference numbers (directed at the drawings) shown in the claims serve to facilitate the correlation of the integers of the claims with illustrated features of the preferred embodiment, but are not intended to restrict in any way the language of the claims to what is shown in the drawings, unless the contrary is clearly apparent from the context.

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List of reference numerals

	101	building
	102	roof
20	103	mast
	104	antennas
	105	remote radio head (RRH), high-frequency transmitter
	106	power supply
	107	base station
25	108	data line
	109	power line
	110	fuse box
	201	coaxial cable
	202	inner conductor
30	202	hollow inner conductor

203	dielectric
204	outer conductor
205	protective jacket
301	tube spiral

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Claims

1. A hybrid cable including a coaxial cable (201) with an outer conductor and a hollow inner conductor (202) that encloses an inner space, wherein a data line (108) is arranged in the inner space of the inner conductor (202).
2. A hybrid cable as claimed in claim 1, wherein the data line (108) is configured as an optical data line.
3. A hybrid cable as claimed in claim 1, wherein the data line (108) is configured as an electrical data line.
4. A hybrid cable as claimed in claim 1, wherein the data line (108) is configured as an optical and electrical data line.
5. A mobile radio system including a hybrid cable as claimed in any one of the preceding claims.
7. A method for the installation and production of a hybrid cable, wherein the method includes at least the following step:
 - introduction of an optical and/or electric data line (108) into a hollow space of a hollow inner conductor (202) of a coaxial cable (201).
8. A method as claimed in claim 7, wherein the method includes at least the following additional step:
 - connecting the inner conductor (202) and an outer conductor (204) to a power supply (106).

6. A hybrid cable according to the invention, as hereinbefore generally described.
- 5 7. A hybrid cable as specifically described with reference to or as illustrated in the accompanying drawings.
8. A hybrid cable including any new and inventive integer or combination of integers, substantially as herein described.
- 10 9. A mobile radio system including at least two adapters according to the invention, as hereinbefore generally described.
10. A mobile radio system including at least two adapters as specifically described with reference to or as illustrated in the accompanying drawings.
- 15 11. A mobile radio system including at least two adapters including any new and inventive integer or combination of integers, substantially as herein described.
- 20 12. A method according to the invention for the installation and production of a hybrid cable substantially as hereinbefore described or exemplified.

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13. A method of installing and producing a hybrid cable, including any new and inventive integer or combination of integers, substantially as herein described

5 DATED AT PRETORIA THIS 24TH DAY OF FEBRUARY 2009.

A handwritten signature in cursive script, appearing to read "Berndt", is written over a horizontal line.

HAHN & HAHN INC.

APPLICANT'S ATTORNEYS

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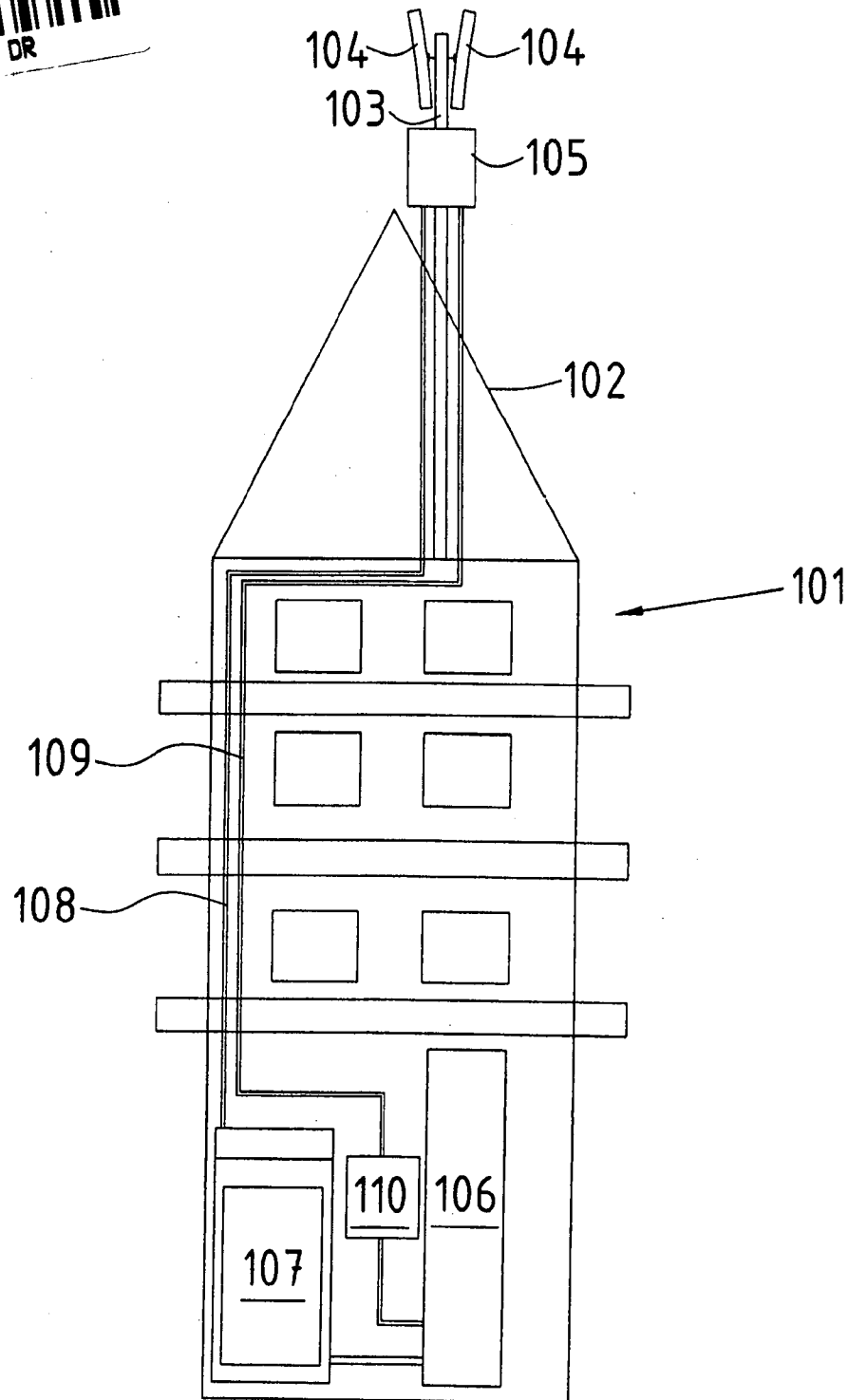


Fig.1

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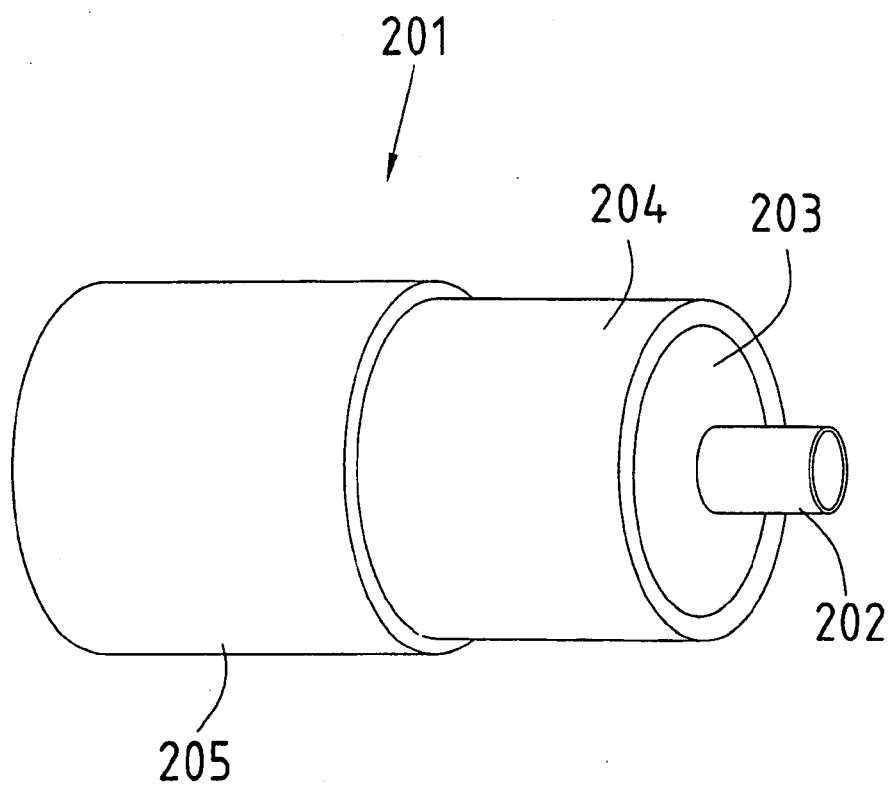


Fig.2

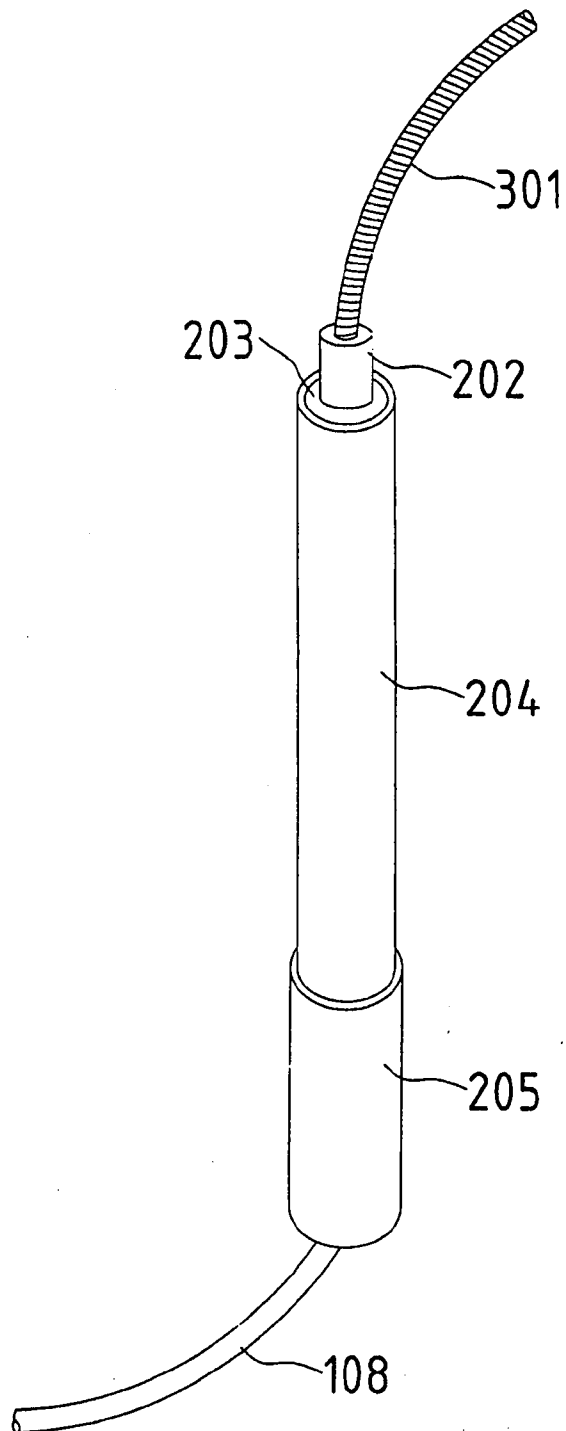


Fig.3

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