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Prudhomme et al.

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[54] **IN-VEHICLE ANTENNA**
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[21] Appl. No.: **406,111**

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[52] U.S. Cl. **455/345; 455/351; 455/575;**
343/711; 343/807

[58] Field of Search **455/345, 346,**
455/347, 348, 349, 350, 351, 89, 90; 343/711,
712, 713, 795, 807, 806

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Assistant Examiner—Lee Nguyen
Attorney, Agent, or Firm—Thomas W. Tolpin

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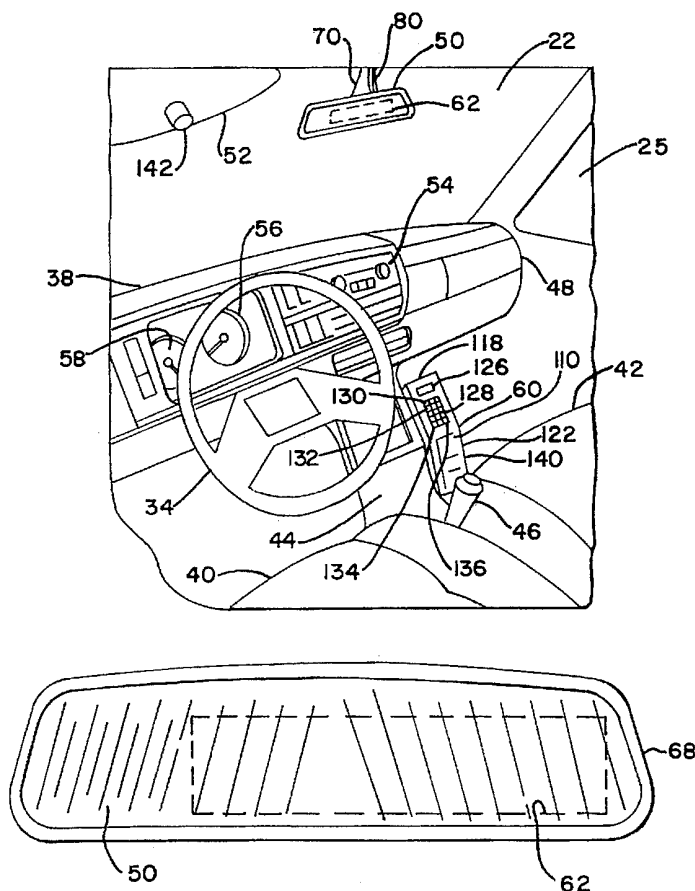
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[57] ABSTRACT

A cellular telephone system has a special cellular telephone antenna that can be hidden from view so as to deter thieves and vandals as well as prevent damage to the antenna during car washes. In the preferred form, the cellular telephone antenna comprises a rear view mirror-mounted antenna. The cellular telephone antenna can also comprise a sun visor mounted antenna, side view mirror-mounted antenna, glove compartment-mounted antenna, or dashboard-mounted antenna.

11 Claims, 3 Drawing Sheets



SAMSUNG 1067

FIG. 1

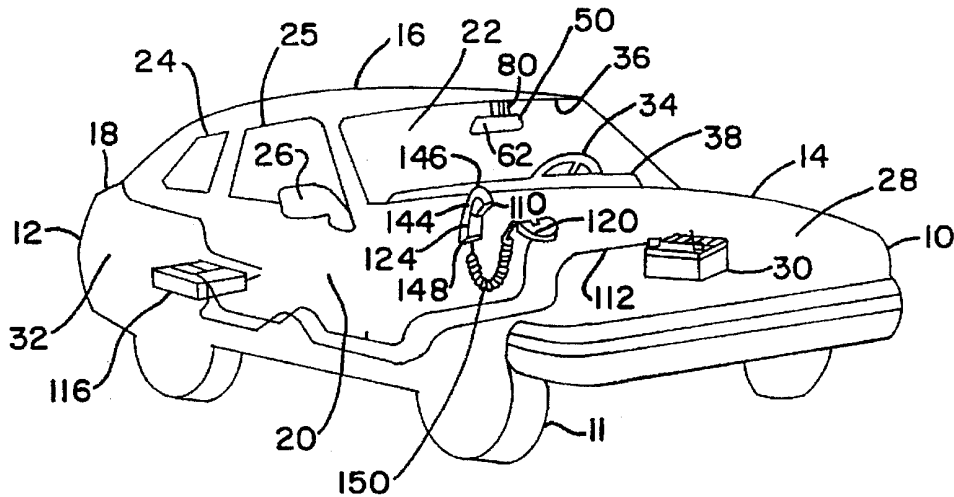


FIG. 2

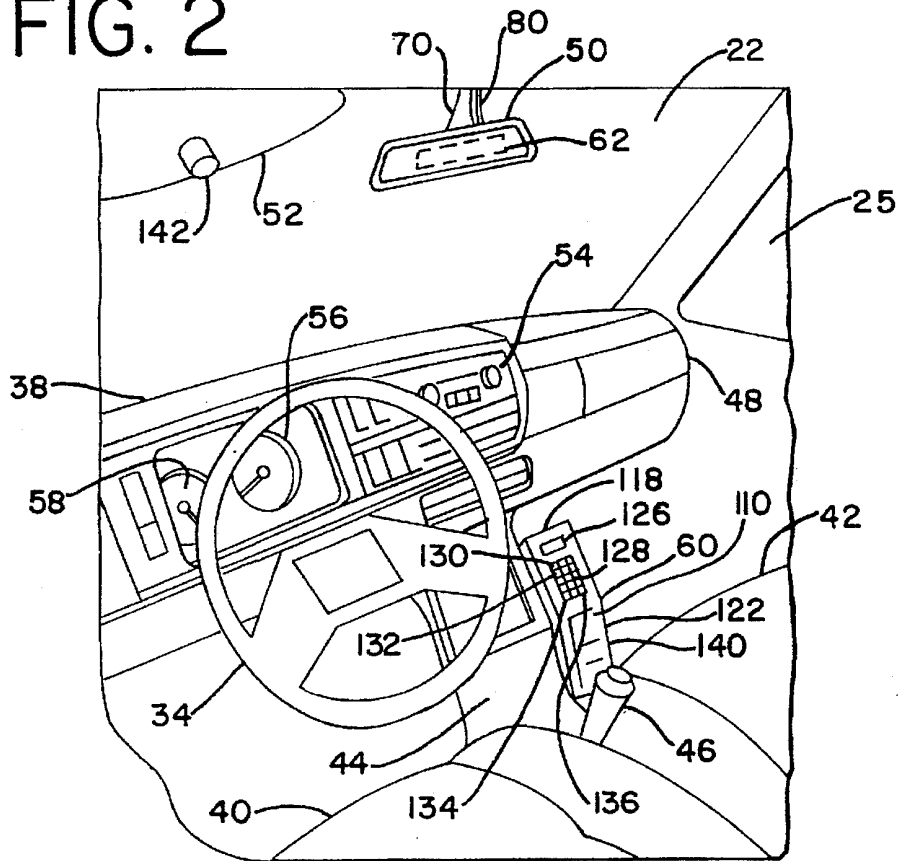


FIG. 3

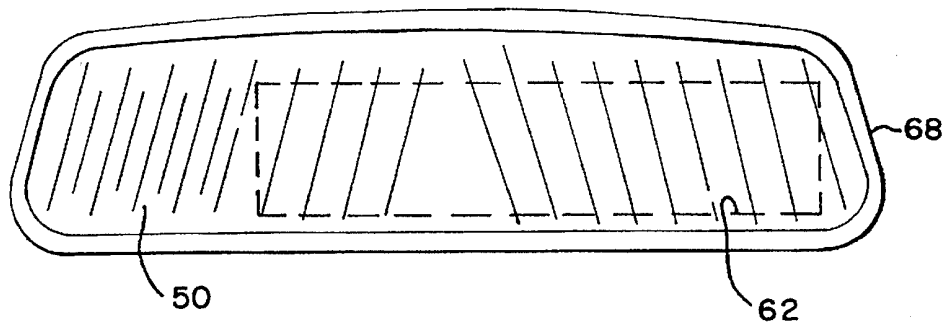


FIG. 4

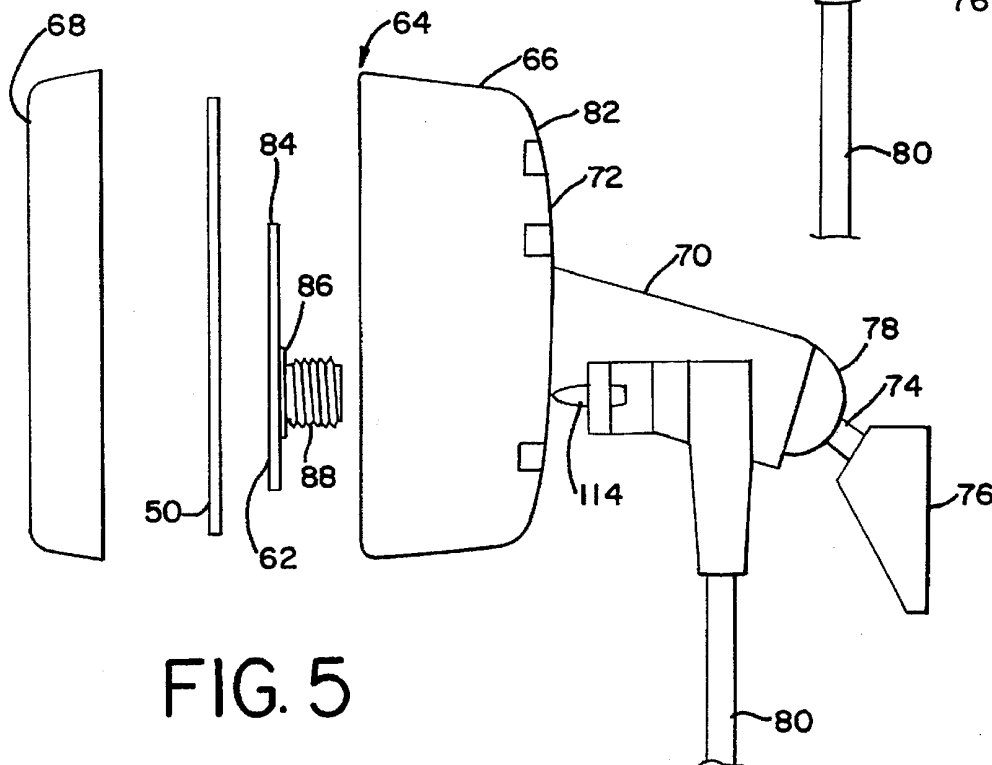
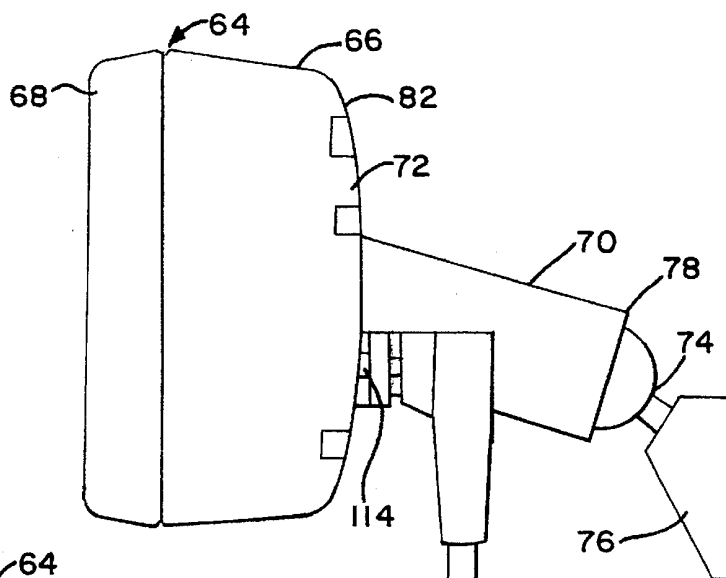
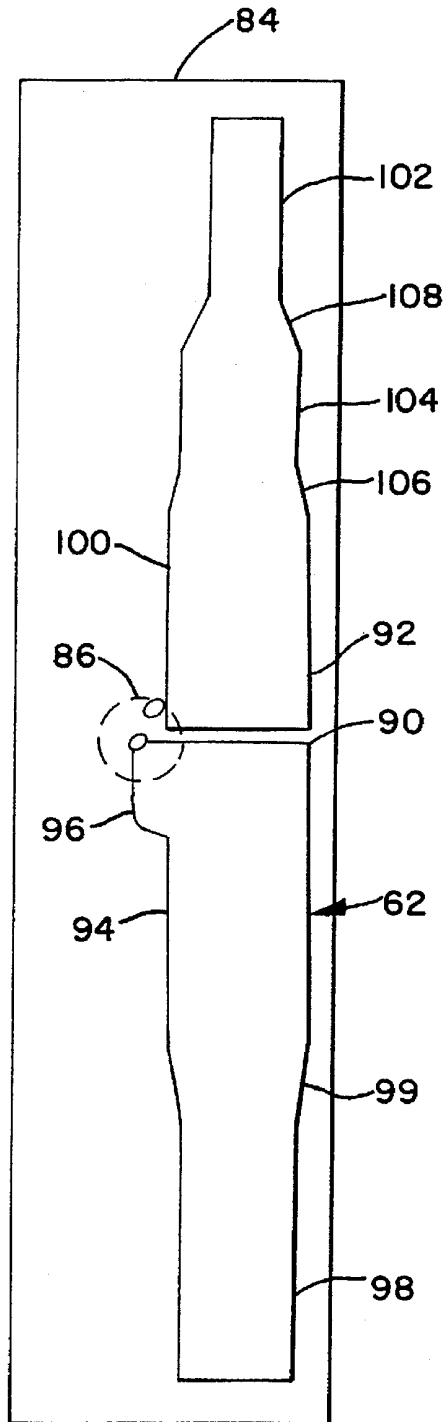


FIG. 5

FIG. 6



IN-VEHICLE ANTENNA

BACKGROUND OF THE INVENTION

This invention pertains to antennas and, more particularly, to antennas for car phones.

Cellular mobile telephone service utilizes radio transmission to provide direct-dial telephone service to car phones in automobiles, vans, trucks, buses, and other vehicles. Since there are no overhead telephone lines which connect the vehicles, both speech and signaling are transmitted by radio waves. This is accomplished through the use of special tones rather than applying a voltage level or detecting a current as is done in overhead telephone lines. The tones will ring the mobile telephone to indicate an incoming call or will indicate a busy signal.

Until recent years, the growth of mobile telephones had been restricted due to the limited number of radio channels available and the limited range, i.e. 25-30 miles, of single base transmitting units. Subsequently, the cellular concept was developed to provide high quality mobile service for more customers at an affordable cost. The basic concept of a cellular system is to reduce the area covered by the transmitter by reducing the power of transmissions. In this manner, concentrated areas of population can have more transmitting stations and therefore, more channels because each transmitter handles numerous telephone conversations. Moreover, because the lower power transmitters cover less area, the same frequency can be reused in a common geographical area.

In a cellular system, the service area is divided into regions called cells. Each cell has equipment to switch, transmit, and receive calls to and from the mobile telephone units located in the cell. A typical cell can have a radius of one to 12 miles. Each cell transmitter and receiver operates on a specified channel. Desirably, each channel is used for many simultaneous conversations at locations which are far enough apart to avoid interference. As the number of mobile users grow, the overloaded cells can be split or divided into smaller cells by adding more transmitters.

Cell sites form the radio link between individual cellular telephones and the telephone system. Each cell station is equipped with a transmitter and receiver coupled to an array of antennas. The cell sites also have a telephone switching network and other support equipment. The cells are located where they will operate most effectively in the radio environment. In urban area, cell sites are usually found on top of the tall buildings. In rural areas, cell sites are located at the highest levels, such as on mountains or on radio towers. To minimize interference, adjacent cells use different frequencies.

The cell sites are interconnected and controlled by radio transmission by switching circuitry through a central mobile telephone switching office (MTSO). The MTSO is linked to the cell sites by a group of voice circuits for conversations, together with one or more data links for signaling and control. A call initiated by a mobile telephone unit can be interconnected by the MTSO to a stationary telephone just as any other telephone call.

The mobile telephone units have a telephone control unit, a handset, a mobile telephone antenna, and interconnecting cables. Each mobile telephone unit is assigned a ten digit telephone number. The control unit performs all the functions associated with normal telephone use. The receiver and transmitter provide a transceiver and they are the means by which signals are sent between the cellular telephone and the cell site. The receiver can tune to frequency modulated (FM)

channels assigned to the cellular system, such as in the 800-900 MHz range. The band from 824-849 MHz is often used to receive signals from the mobile units. The transmitter can tune to the appropriate FM band. The band from 869-894 MHz is often used to transmit signals to the mobile units. The mobile units transmits at a low power. The base station transmits at a higher power.

Generally, each cellular telephone has a small integrated circuit or chip providing a numeric assignment module (NAM). The NAM chip is programmed usually by the cellular telephone dealer or installer to contain the information that uniquely identifies the cellular telephone with a cell site. The information programmed in the NAM chip includes the telephone number and serial number of the cellular telephone. The computers at the MTSO and the cell site use this information to identify the particular cellular telephone when transmitting and receiving calls.

Most cellular telephone manufacturers and supplies offer hands-free accessories that make it unnecessary to hold the handset while talking on the cellular telephone. A typical hands-free installation, includes a small microphone, which clips onto the windshield's sun visor to pick up the driver's end of the conversation and a speaker in the control head of the cellular telephone. Removing the handset from its cradle restores the cellular telephone to its normal operation and deactivates the microphone external speaker (speaker phone) to end the hands-free mode.

When the handset is lifted or a button is pressed to place a call, the MTSO automatically selects an available channel. The user hears the normal dial tone and can continue dialing, i.e. pressing the alpha/numeric buttons, in the same manner as a stationary telephone with overhead telephone lines. An incoming call to the mobile unit is signaled by a ringing tone and is answered simply by lifting the handset or pressing the receive button. The mobile telephone transmitter is linked by a voice channel to another telephone, such as another mobile telephone or a stationary telephone.

Each cell site has at least one setup channel dedicated to signal between the cell and its mobile units. The remaining channels are for conversations. Two channels are required for duplex operation. A mobile telephone unit is called by transmitting its number over the setup channel. This occurs when the cellular telephone is taken off-hook. The cellular transmitter links to an available set-up channel and send a request tone to the serving cell site. The cell site assigns a voice channel set over which dialing and voice signals will take place. The cellular control circuit automatically switches to the voice channel. The cell site interprets incoming dial tones and send the digits along to the MTSO which will connect the cellular telephone to the recipient telephone. When the recipient telephone is taken off-hook, the telephone are linked and a conversation can take place. As vehicles move (roam) out of the cells and the cellular signal becomes weaker, the MTSO switches to another cell to establish a new voice channel with a stronger signal, by a switching procedure known as a handoff. Handoffs take place so rapidly by a computerized switching system, that cellular users do not even know that it has occurred.

In most mobile cellular phone installations, the phone receives its power from a vehicle battery. If it is part of a permanent installation, the phone may be permanently connected, or hard wired, to the vehicle's electrical system. If the phone is intended to be removed occasionally, a quick disconnect plug or an adapter that lets the telephone take its power from the vehicle's cigarette lighter can be used.

For permanent installations, the transceiver/logic unit can be mounted in the trunk of the automobile and connected to

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