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De Nicolo

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(54) **POWER FEED FOR NETWORK DEVICES**

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(63) Continuation of application No. 09/048,922, filed on Mar. 26, 1998, now Pat. No. 6,115,468.

(51) **Int. Cl.**[7] **H04M 1/00**
(52) **U.S. Cl.** **379/413**; 379/412; 379/324; 375/257; 375/258; 375/285; 333/177
(58) **Field of Search** 379/413, 412, 379/400, 324, 90.01; 375/257, 258, 285; 370/352, 356; 333/177, 32; 363/17; 323/247, 270

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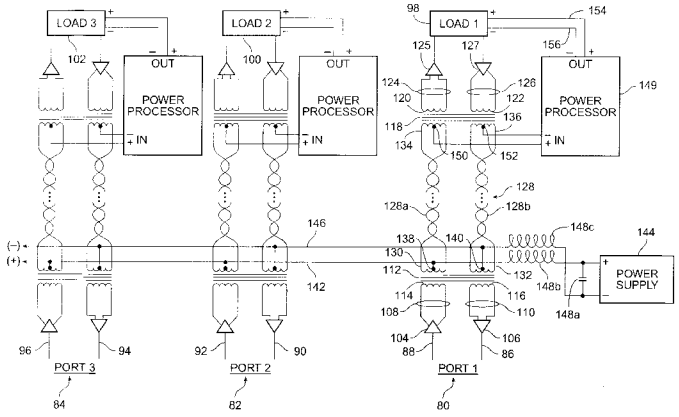
(57) **ABSTRACT**

An Ethernet device power transmission system includes an input transformer, an output transformer and a pair of twisted pair conductors. The input transformer includes a pair of primaries for connection to a source of Ethernet data. The input transformer also includes a pair of secondaries, each having a center-tap. A first twisted pair conductor is connected across the first secondary, a second twisted pair conductor is connected across the second secondary and a DC-bias is provided between the respective center taps of the first and second secondaries. At the local end, the output transformer includes a first and second center-tapped primary and a first and second secondary for connection to the load device. The first and second primary center taps are connected to a power processor for extraction of DC power.

60 Claims, 3 Drawing Sheets



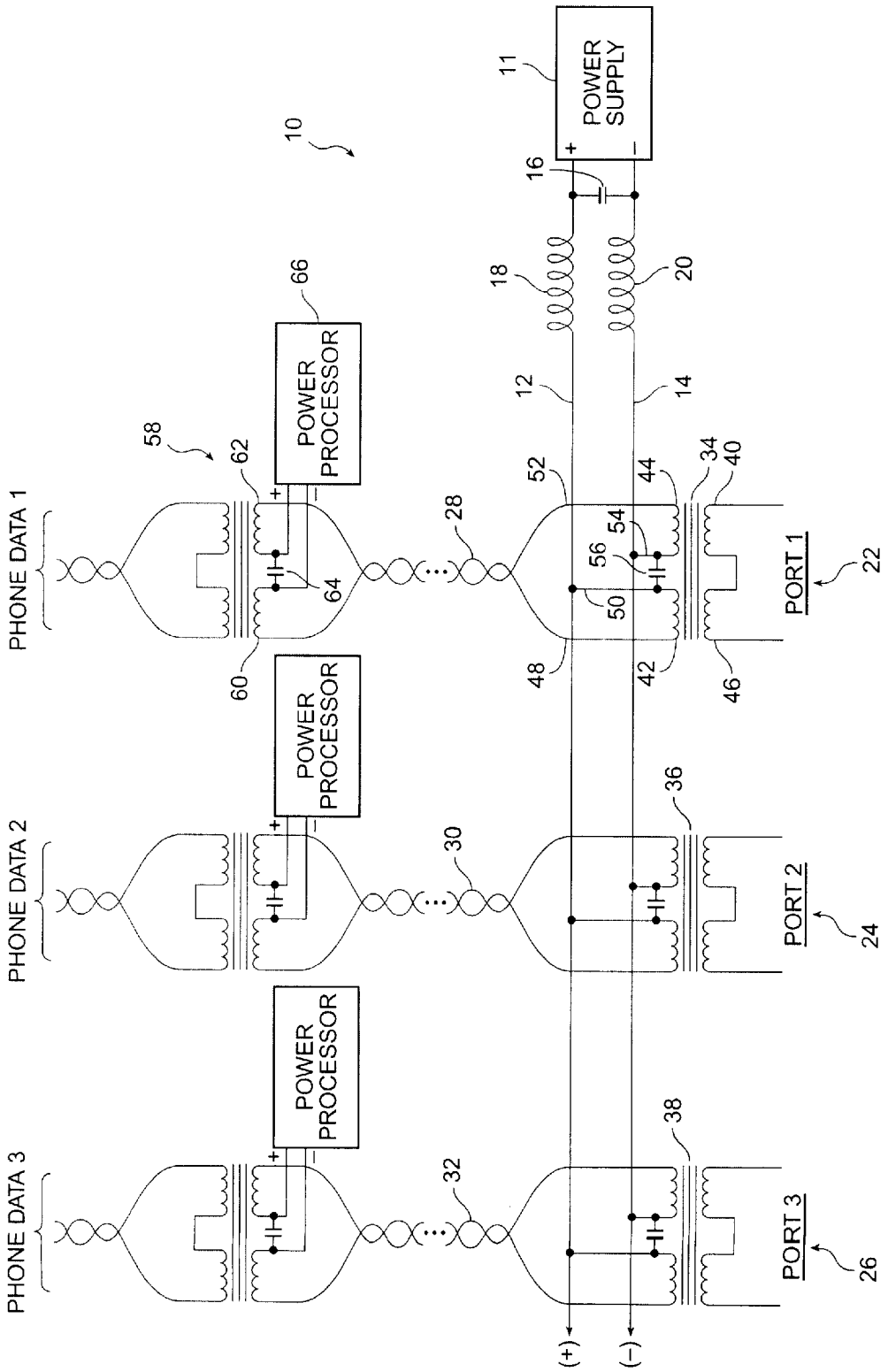


FIG. 1
(PRIOR ART)

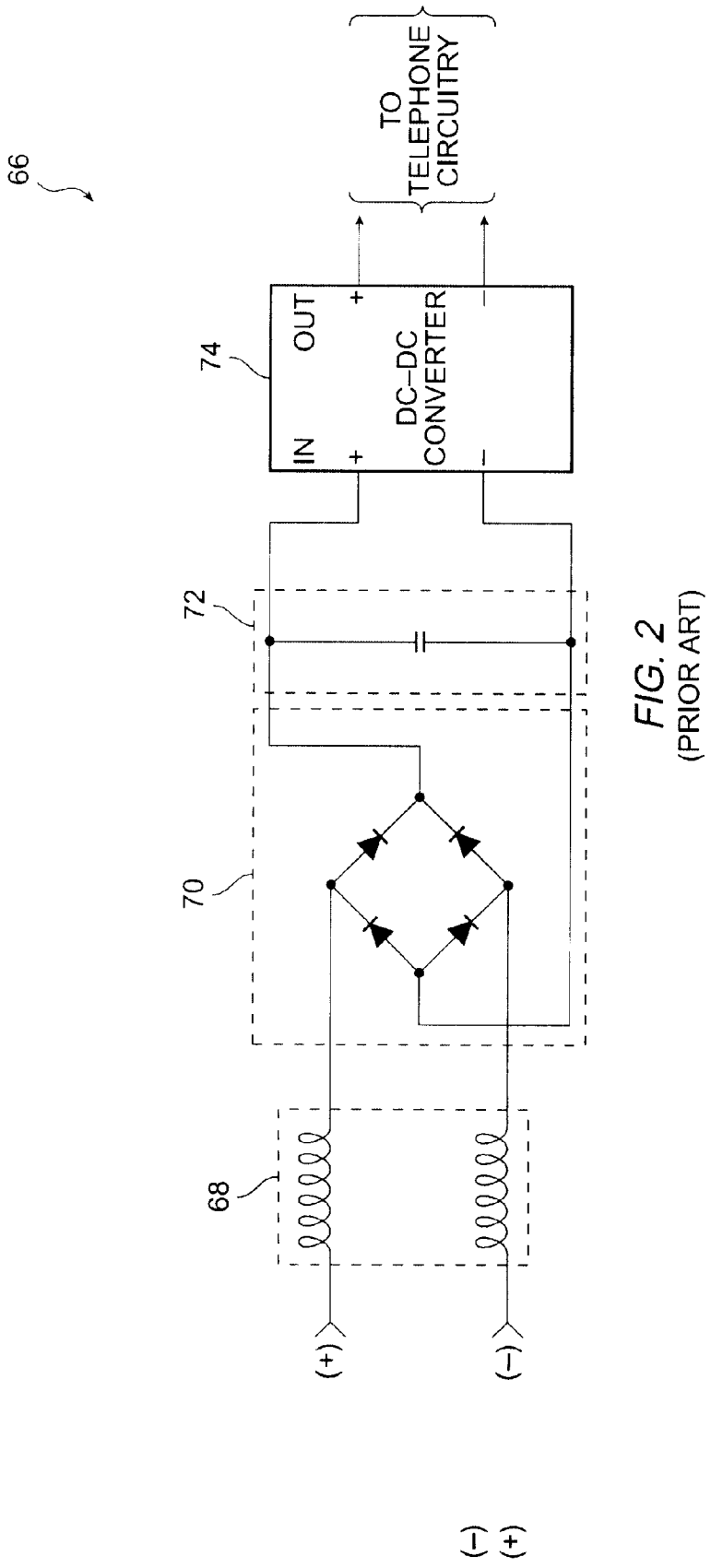


FIG. 2
(PRIOR ART)

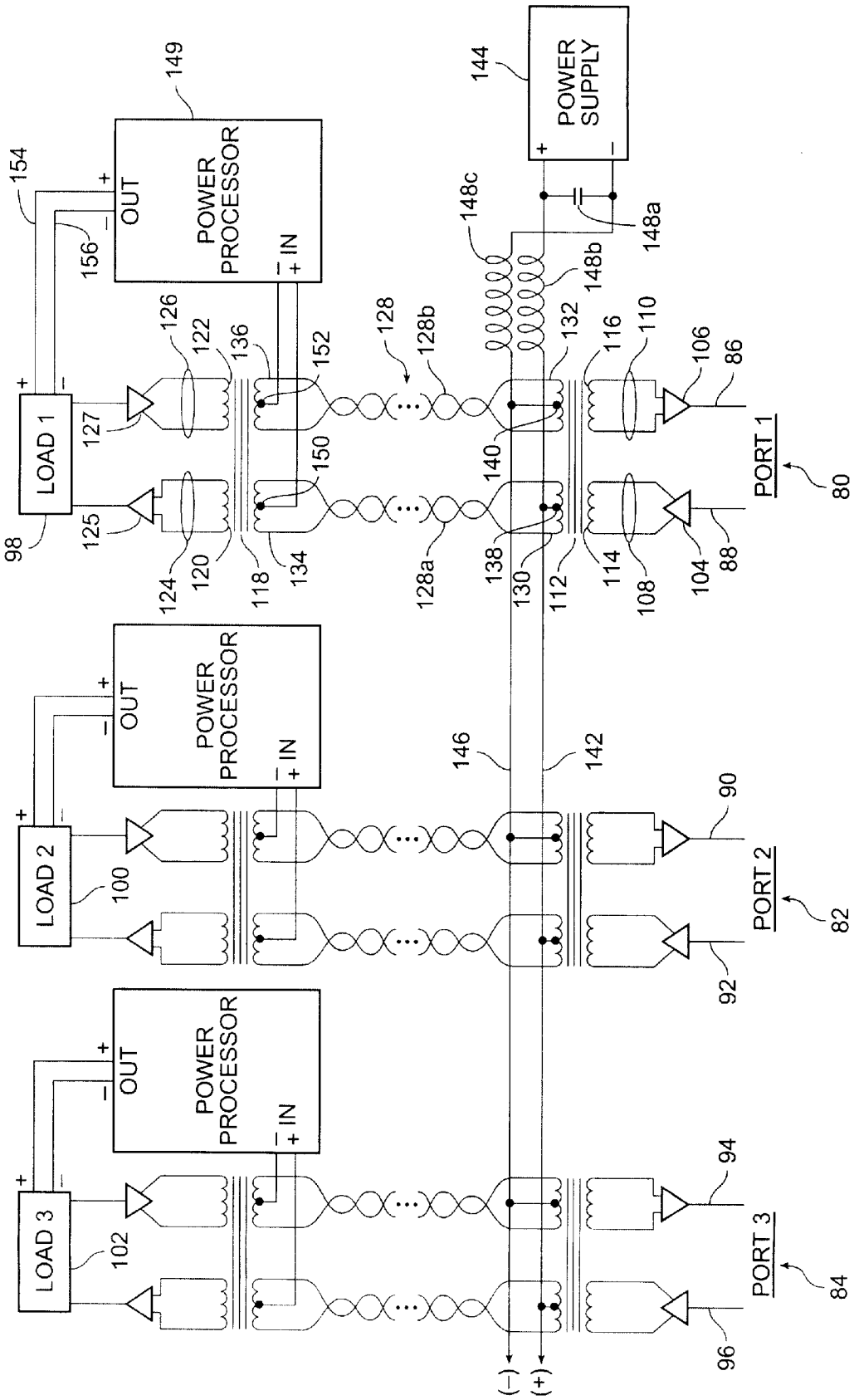


FIG. 3

POWER FEED FOR NETWORK DEVICES

This application is a continuation of Ser. No. 09/048,922 filed Mar. 26, 1998 U.S. Pat. No. 6,115,468.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention is directed to a method and apparatus which provide electrical power to ethernet-based telephones over an ethernet wire link.

2. The Background Art

Telephones require electrical power in order to operate. The power can be delivered over the telephone lines or via a separate power connection, typically through a power transformer connected to the electrical power grid. Telephones powered in the latter fashion will be inoperable during a power failure unless provision is made both locally at the telephone and at the PBX or local telephone switch for emergency power to be supplied. While it is normal to provide an uninterruptible power supply to an office's PBX or telephone switch, it is not desirable for cost and other reasons to provide electrical power back up systems to each telephone location. In the past, the power problem was frequently solved by using an 8-wire telephone connection to the telephone switch. With 8 wires there is more than enough capability for analog audio digital and power connections to the telephone switch.

The growth of the Internet and similar local and wide area networks based on Ethernet technology has created a potential market for telephone systems which would connect directly to existing Ethernet connections. The Ethernet protocol, however, does not provide a mechanism for powering such telephones. A typical Ethernet connection to an office location would include a pair of unshielded twisted pair (UTP) lines for a total of four conductors—one pair for transmit, one for receive. The transmit pair is dedicated to send packets of data over the Ethernet connection; the receive pair receives packets of data over the Ethernet connection. Simply placing a DC bias on two or more of these conductors and using the bias to power a local Ethernet telephone is risky because the bias is not part of the Ethernet protocol and might damage Ethernet compliant equipment not designed to handle such a bias.

Turning to FIGS. **1** and **2**, a prior art scheme for providing power over a single twisted pair connection is shown. In the prior art, system **10** and power supply **11** provides DC power over lines **12** (positive lead) and **14** (negative lead) to a series of ports on the network. Filter capacitor **16** and filter inductors **18** and **20** are preferably provided to insure a clean source of DC power and to avoid AC cross-talk between the network and the power supply. Each port **22**, **24** and **26** of the network is coupled to a twisted pair link **28**, **30** and **32**, respectively, via a transformer, **34**, **36**, and **38**, respectively. Transformer **34**, for example, operates as follows: Data on port **1** (**22**) is applied to the primary **40** of transformer **34** and coupled to a pair of secondary winding **42**, **44** of transformer **34** through transformer core **46** in a conventional manner. One end **48** of secondary winding **42** is connected to twisted pair **28** and the other end **50** of secondary winding **42** is connected to the positive lead **12** of power supply **11**. One end **52** of secondary winding **44** is connected to twisted pair link **28** and the other end **54** of secondary winding **44** is connected to the negative lead **14** of power supply **11**. Leads **50** and **54** are AC-coupled to one another with capacitor **56** as shown. This blocks DC current from flowing and allows a DC bias to be established over the two conductors of twisted pair link **28** while simultaneously allowing the flow of data over the link.

At the telephone end of the twisted-pair link **28**, a similarly structured transformer **58** receives the data signal as well as the DC bias. First primary **60** and second primary **62** are AC-coupled with capacitor **64** so as to be able to couple data signals from twisted-pair link **28** with transformer **58** while holding off a DC bias. The DC bias of twisted-pair link **28** is applied to a power processor **66** and from there provides to local equipment to be powered by the twisted pair system. A typical embodiment of a power processor **66** is shown in FIG. **2**. It comprises a filter **68**, a rectifier **70**, a filter capacitor **72** and a DC-DC converter **74**.

While fit for its intended purpose, the above-described system has some drawbacks which make it a less than ideal choice for an Ethernet environment. For example, each secondary **42** and **44** of transformer **34** and each primary **60** and **62** of transformer **58** will experience a net current flow equal to the total amount of current drawn by the load at the distal end of the twisted-pair link. This current will affect the choice of transformer core size at each end of the link and will affect the choice of wire gauge used for the link.

It would be desirable to provide an improved method and apparatus for powering Ethernet telephones over a 4-wire link. Such a system would be able to take advantage of existing wiring without the need to rewire the premises to install such devices. Furthermore, by providing power over the Ethernet connection, power transformers are not required at the device location, and a central uninterruptible power supply is made possible to provide power to the entire telephone system in case of a power failure.

SUMMARY OF THE INVENTION

An Ethernet device power transmission system provides electrical power to devices such as Ethernet telephones and related equipment over a 4-wire Ethernet connection without any need for rewiring premises having an existing 4-wire Ethernet system. The system eliminates any requirement for local power such as transformers to power such equipment as all power can be provided over the existing Ethernet wiring. A central uninterruptible power supply (UPS) is thereby made possible to provide back-up power to all such equipment. The system includes an input transformer, an output transformer and a pair of twisted pair conductors. The input transformer includes a pair of primaries for connection to a source of Ethernet data. The input transformer also includes a pair of secondaries, each having a center-tap. A first twisted pair conductor is connected across the first secondary, a second twisted pair conductor is connected across the second secondary and a DC-bias is provided between the respective center taps of the first and second secondaries. At the local end, the output transformer includes a first and second center-tapped primary and a first and second secondary for connection to the load device. The first and second primary center taps are connected to a power processor for extraction of DC power.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an electrical schematic diagram of a prior art telephone power distribution system for use over a two-wire twisted pair system.

FIG. **2** is an electrical schematic diagram of a prior art telephone power extraction system or power processor.

FIG. **3** is an electrical schematic diagram of an Ethernet telephone power distribution system according to a presently preferred embodiment of the present invention.

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