US 20110149527A1

(19) **United States**

(12) **Patent Application Publication**

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(10) **Pub. No.: US 2011/0149527 A1**

(43) **Pub. Date: Jun. 23, 2011**

(54) **MULTISPUR FIELDBUS BARRIER ARRANGEMENT**

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(21) Appl. No.: **13/062,004**

(22) PCT Filed: **Sep. 2, 2009**

(86) PCT No.: **PCT/GB2009/051106**

§ 371 (c)(1), (2), (4) Date: **Mar. 3, 2011**

(30) **Foreign Application Priority Data**

Sep. 4, 2008 (GB) 0816121.8

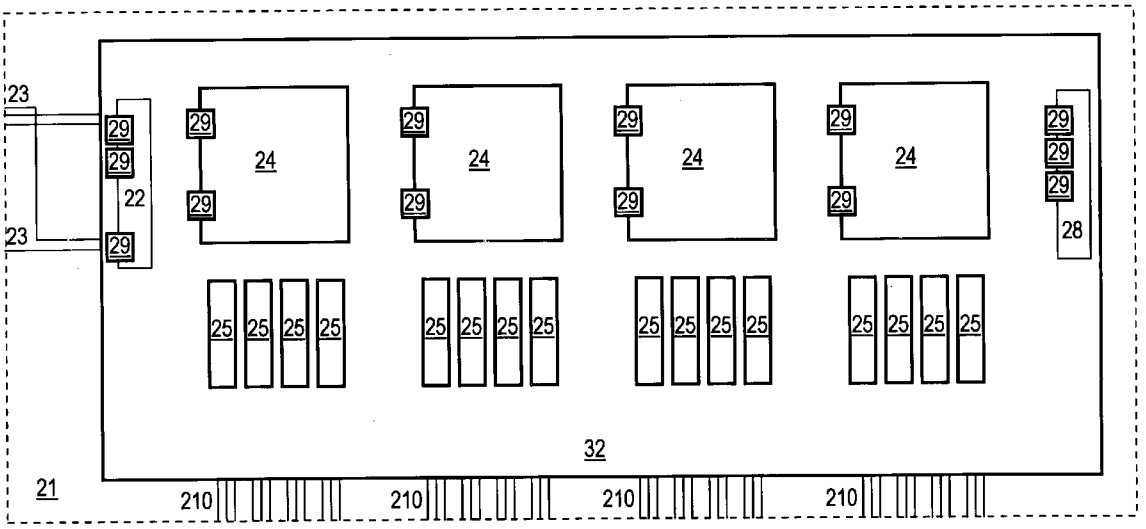
Publication Classification

(51) **Int. Cl.**
H05K 5/00 (2006.01)

(52) **U.S. Cl.** **361/730**

(57) **ABSTRACT**

The present invention provides for a multispur fieldbus barrier arrangement having a trunk connection (**23**) and in which each of a plurality of spurs (**210**) is connected to the trunk (**23**) by barrier devices (**24**), where each barrier device (**24**) comprises a removably mounted modular unit arranged for plug-in connection to the trunk (**13**) by means of a flameproof connection (**29**) and further wherein a redundant barrier device can likewise be included for activation responsive to failure of a barrier device.



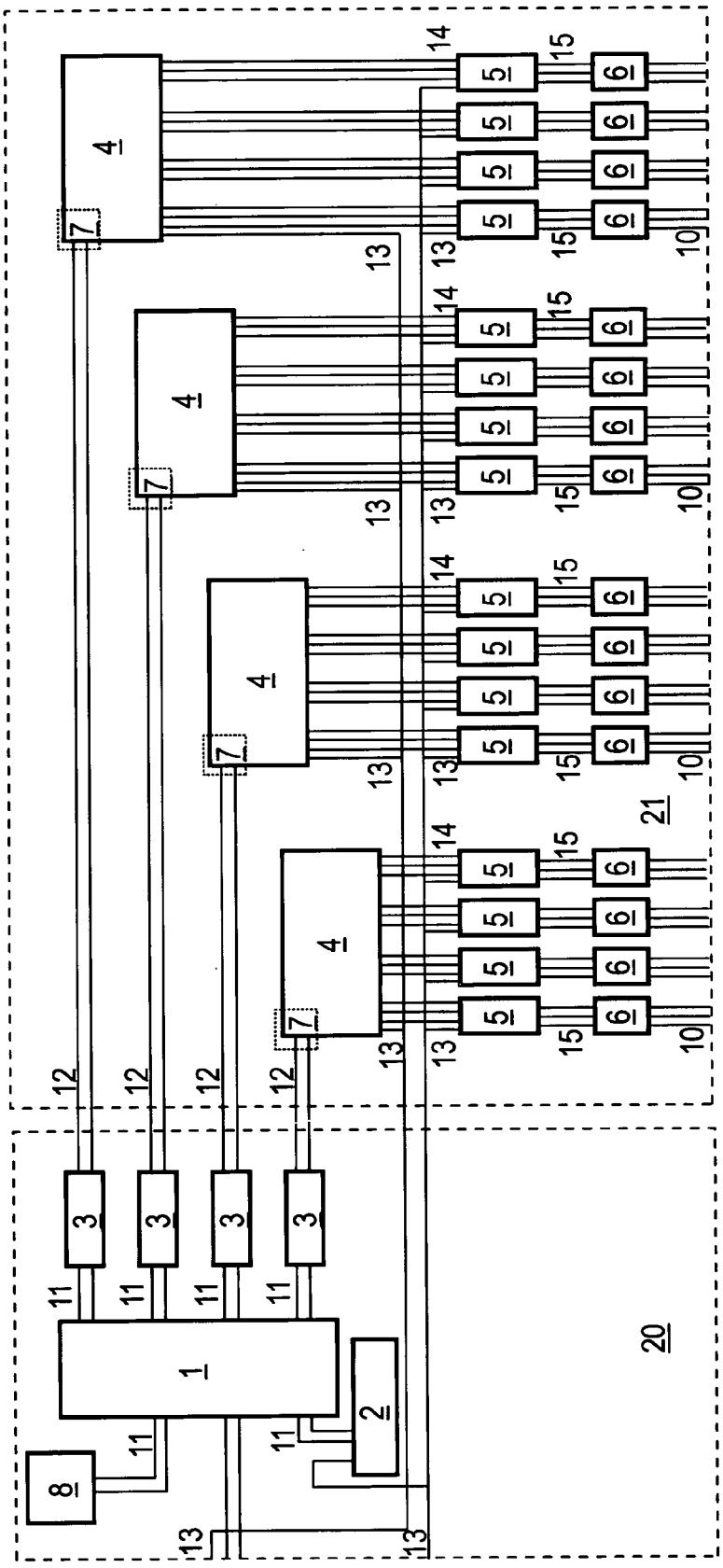


FIG.1.

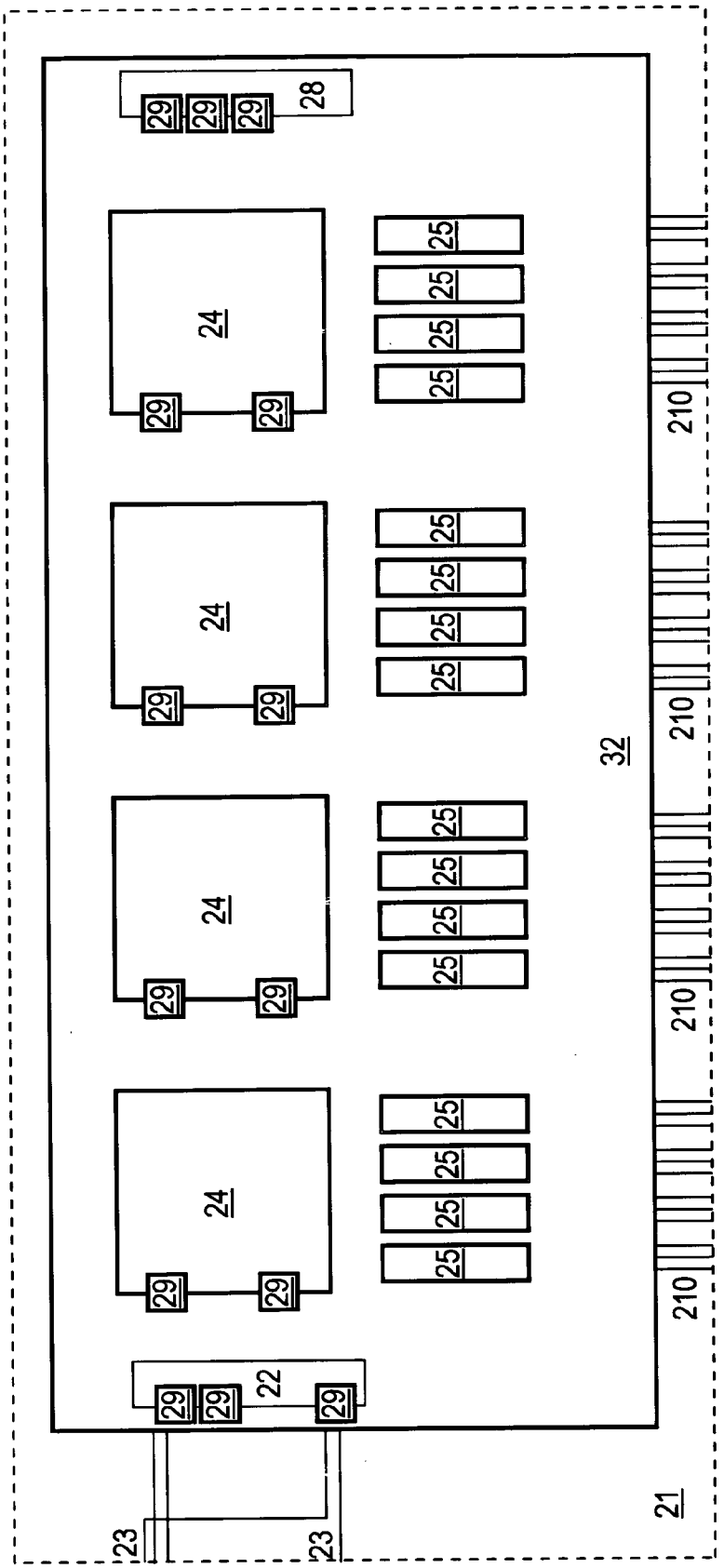


FIG.2.

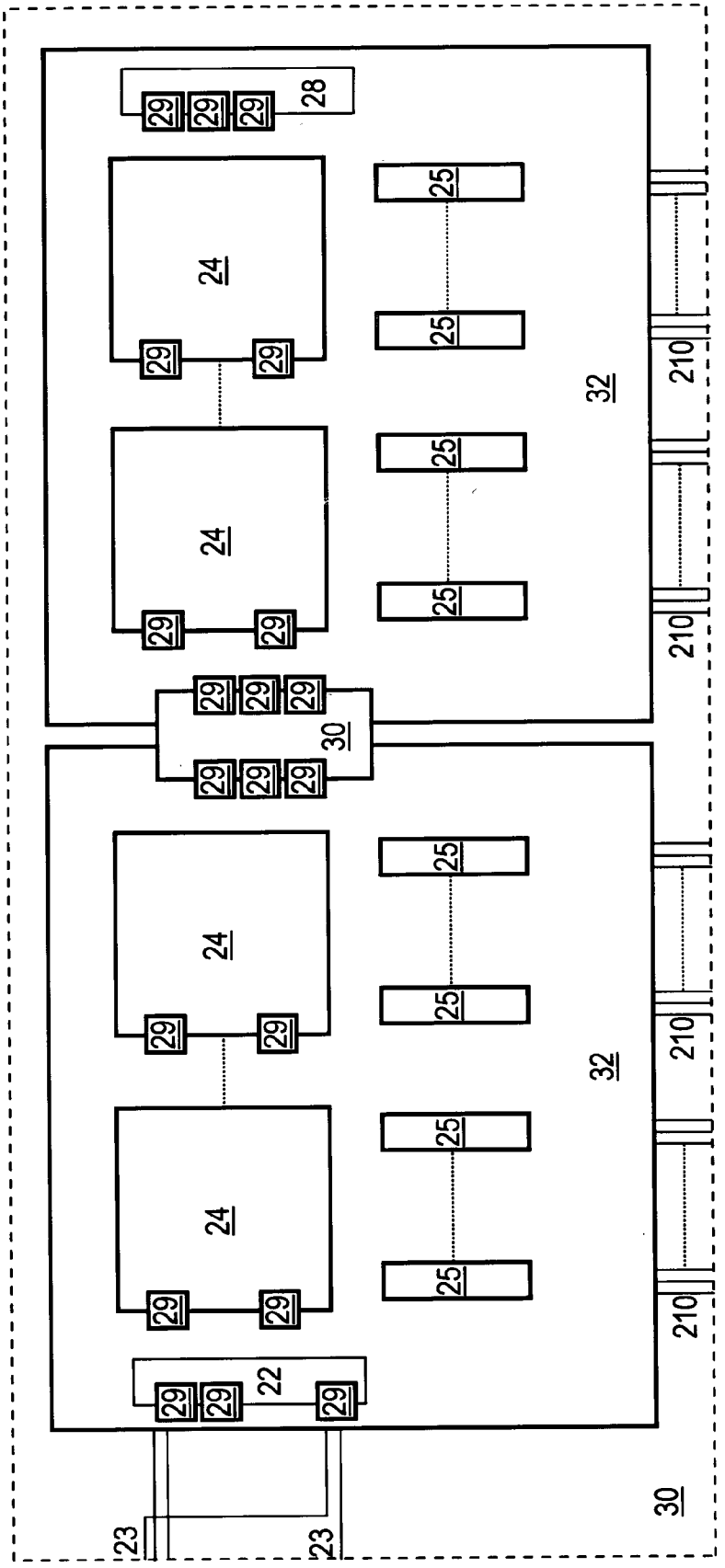


FIG.3.

MULTISPUR FIELDBUS BARRIER ARRANGEMENT

[0001] The present invention relates to a fieldbus isolated coupler better known as a fieldbus barrier forming part of an Intrinsically Safe (IS) system for supplying power and/or signals into hazardous areas, and in particular to a multispur fieldbus barrier arrangement for supply of power and/or signals to a variety of different devices within an IS environment. In addition to the provision of simple fieldbus barrier devices for use in supplying an IS field device operating within a hazardous area, multispur fieldbus barrier arrangements are known having a trunk connection means for the connection of a trunk connection bus, and offering a plurality of spur outlets through which any appropriate number and variety of remote field devices can be supplied and/or addressed.

[0002] In such known systems, a variety of fieldbus barrier devices are provided, commonly with each one providing barrier protection for a plurality of spur outlets.

[0003] However, such known systems and arrangements prove disadvantageous and limiting with respect to matters of cost and ease of use and particularly where the multispur arrangement itself might have to be located within a potentially hazardous environment. In particular, such devices require extensive wiring connections which can lead to unnecessary size and complexity and labour-cost issues and the number, type, and general size of the enclosures required can also prove problematic and limiting. Should any changes/repairs to the system be required, it becomes necessary to power-down the fieldbus trunk. Also, surge limiter replacement carries the risk of adjacent-channel shorts and can require, depending on the specific characteristics of the particular environment, gas clearance for full power disconnection.

[0004] The present invention seeks to provide for a multispur fieldbus barrier arrangement having advantages over known such arrangements.

[0005] According to a first aspect of the present invention there is provided a multispur fieldbus barrier arrangement having trunk connection means and in which each of a plurality of spurs is connected to the trunk by barrier and surge protector devices, wherein each barrier device comprises a removably mounted modular unit arranged for plug-in connection to the trunk by means of a flameproof connection so as to provide for a non-hazardous connection.

[0006] The provision of the barrier device in the form of a removably mounted modular unit assists greatly in reducing the wiring, and overall size of the arrangement and, in particular, use of the aforementioned flameproof connectors in connecting to the trunk allows for the advantageous use of a multispur arrangement within a potentially hazardous environment.

[0007] Advantageously, the trunk connection, modular barrier units and surge protectors are disposed to be mounted onto the support means of the system.

[0008] In particular, since the support means can comprise a back plane, advantageously, the surge protectors can be removably mounted within the arrangement and without requiring neither removal of power from the trunk nor removal of power to the spur on which the surge protector is mounted.

[0009] In accordance with one aspect of the invention, the multispur arrangement can include redundant modular barrier device units arranged for interconnection to spur outlets associated with a failed unit.

[0010] In particular, the redundant modular barrier device can be arranged for interconnection to such spur outlets of the failed unit in a manner responsive to an indication of failure of the failed unit.

[0011] The invention can further provide control means for configuring the connection of the redundant modular barrier device units to the spur outlets.

[0012] In particular, each modular barrier unit can be arranged to provide protection for a plurality of spur outlets.

[0013] Yet further, removably mounted trunk surge protector devices and/or removably mounted terminator devices can be provided and including flameproof connectors.

[0014] According to another aspect of the present invention there is provided a fieldbus barrier device arranged to be removably mounted in a multispur fieldbus barrier system and between a trunk connector and spur outlets, and comprising flameproof connector means for connection to the said trunk of the system.

[0015] Advantageously, the flameproof connector means comprise plug-connectors arranged for the removable mounting of the fieldbus barrier device.

[0016] Further, the fieldbus barrier device can include plug connector means for connection with surge protectors of the multispur fieldbus barrier system.

[0017] Yet further, the fieldbus barrier device can be arranged to be mounted by said flameproof connectors to support means of the multispur fieldbus barrier system which can comprise a back plane.

[0018] It should be appreciated therefore that the fieldbus barrier device can comprise a modular readily removable plug-in device.

[0019] The present invention can therefore advantageously allow for an effective "plug and play" solution to the provision of an appropriate number of fieldbus barrier devices within a multispur fieldbus barrier arrangement and which can readily provide for redundancy within the arrangement. The modular plug-in fieldbus barrier devices can be easily and quickly mounted as required and so maintenance of the device, and likewise the overall system arrangement, is likewise enhanced.

[0020] The whole system can therefore be readily tested, and appropriate adjustments and/or replacements made as required, before full installation.

[0021] As regards the location of the multispur unit within hazardous areas, it is considered that it can be readily mounted within a Zone 1 environment whilst still allowing for live disconnection/reconnection. Also, when compared with the current art, the overall volume of the enclosure, and indeed the number of enclosures required, is vastly reduced having advantageous cost implications.

[0022] Through the lack of manual input in building the system, and in particular removing the need for extensive wiring, the overall system is found to be more reliable and any required replacement of a barrier device can be achieved without disconnecting power or requiring gas clearance. Likewise, any spur surge protector insertion/replacement/removal, and/or any trunk surge protector insertion/replacement/removal, and/or any terminator insertion/replacement/removal, can be achieved while the system remains working.

[0023] The invention is described further hereinafter, by way of example only, with reference to the accompanying drawings in which:

[0024] FIG. **1** is a plan view of a conventional multispur fieldbus barrier arrangement;

[0025] FIG. **2** is a similar block diagram offering the same functionality as that of FIG. **1** but illustrating the multispur fieldbus arrangement according to an embodiment of the present invention; and

[0026] FIG. **3** is a similar block schematic diagram illustrating a multispur fieldbus arrangement according to another embodiment of the present invention.

[0027] Turning first to FIG. **1**, there is provided a plan view of a typical conventional sixteen spur fieldbus barrier system arranged for connection to an input trunk, and for provision of output signals on sixteen spurs.

[0028] As will be appreciated from the discussion below, the sixteen spurs are divided into groups of four, each of which is provided with a signal from a four-spur barrier.

[0029] As illustrated in FIG. **1**, there is provided an Exe terminal block **1** and associated trunk surge protector **2**, and Exde safety flameproof switches **3** each of which feeds to a respective one of the four-spur barriers which in turn have outputs connected to four spur outlets which are also fed by way of respective surge protectors **5** and terminal blocks **6**.

[0030] Each of the four-spur barriers **4** is associated with a security cover **7** serving to prevent access to, and removal of, the connection without deactivating the flameproof switches **3**. Also provided connected to the terminal block **1** is a terminator unit **8**.

[0031] The actual external wiring to the spurs for the remote devices **10** leads from the respective terminal blocks **6**. Also internal wiring and trunking **11** is provided for connection between external wiring **13** to the trunk and the terminal block **1** and wiring **11** is likewise provided for connection between the terminal block **1** and the safety flameproof switches **3**. Further internal wiring **12** is provided for feeding from the flameproof switches **3** to the barriers **4** and internal wiring **14**, **15** provides for connection between the barriers **4** and the terminal blocks **6** and also the surge protectors **5** and the terminal blocks **6**. Also, each of the surge protectors **5** is fed directly by the external wiring **13** as illustrated.

[0032] As will be appreciated, the terminal block **8**, trunk surge protector **2**, flameproof switches **3** and associated wiring connections **11** as illustrated are provided within a separate enclosure **20**.

[0033] The remainder of the system comprising the four-spur barriers **4** and associated surge protectors **5** and terminal blocks **6**, and of course the associated internal wiring and elements of the external wiring **13** and internal wiring **12** as illustrated, is provided within a separate main enclosure **21**.

[0034] As discussed previously, a variety of disadvantages arise in relation to such known systems not least of which is that removal of the various devices, and in particular the four-spur barriers **4** requires gas clearance and/or a power-down. Also, the use of the multiple flameproof switches **3** is found to be expensive and bulky.

[0035] In particular, the extensive internal wiring and trunking **12**, **13**, **14**, **15** (as illustrated) disadvantageously necessitates the employment of wire, cable, two-ferrules per wire, and associated heatshrinking, trunking support, rows of terminal blocks, din rails and din rail supports which all serve to exaggerate the complexity and size of known arrangements. High labour costs are experienced in fitting the various mechanical parts of the system, in particular the din rails, and for stripping the wires, crimping the ferrules, heat shrinking the cable protectors that are all associated with the extensive wiring as illustrated in FIG. **1**.

[0036] Any required changes cannot all be achieved on a live basis and the fieldbus has to be powered-down, which will effectively stop the plant in which the hazardous environment is found. Any required replacement of the surge protectors **5** will require disconnection of the spur and create a risk of adjacent-channel shorts. Further, any required replacement of the trunk surge protector **2** will require either gas clearance or disconnection of the power.

[0037] Also, it is a necessity that the four trunk-to-barrier connections **7** are changed by different personnel as compared with the remainder of the wiring and this leads to additional cost, and complexity and possibly down-time for the system.

[0038] Also, there is no scope for the provision of redundancy within the arrangement illustrated in FIG. **1**.

[0039] Turning now to FIG. **2** there is provided a schematic block diagram of a multispur fieldbus barrier system according to an embodiment of the present invention.

[0040] Again, a trunk surge protector **22** is provided along with four-spur barrier devices **24**, each associated with four surge protectors **25** from which extends external wiring of spur outlets **210** to the remote located field devices on each of the sixteen spurs. A terminator **28** is provided, and external wiring **23** from the trunk arrives within the system, by way of the trunk surge protector **22**.

[0041] The complete system is provided within a single enclosure **30** and each of the trunk surge protector **22**, the four-spur barrier devices **24**, spur surge protectors **25** and terminator **28** are provided in a removably mounted by way of plug-in connectors to a carrier **32** which can comprise a backplane for the whole system.

[0042] The backplane **32** includes the predefined electrical connection between the components as illustrated and thereby removes the need for the extensive wiring found in conventional systems.

[0043] Importantly, through the use of flameproof connectors **29**, i.e. connectors arranged to provide for a non-hazardous connection, for connection of each of the barrier devices **24** with the external trunk wiring **23**, the system itself can advantageously be located in a hazardous area as required.

[0044] The trunk surge protector **22**, and terminator **28** can likewise be provided in a plug-in fashion by way of the flameproof connectors **29** illustrated to the carrier **32** without compromising the required level of at least "Zone 1" safety. Alternatively however, the terminator **28** can be provided as an integral part of the backplane carrier **32**.

[0045] The overall size of the enclosure **30** of the embodiment of FIG. **2** can therefore be greatly reduced as compared with that employed in conventional systems such as illustrated in FIG. **1**.

[0046] Another important point of advantageous comparison between the present invention and the prior art is clear from the comparison of FIGS. **1** and **2** and, in particular, the respective trunks **13** thereof. Within known systems such as that illustrated in FIG. **1**, the trunk **13** is, as mentioned, connected to the connector **1** by way of jumpers or other appropriate means, in order to provide for yet further trunks **11** which, in turn, are connected to the Exed switches **3**. The

switchable trunks **12** are then, likewise in turn, connected to the barriers **5** by way of the intermediate Exe trunk connection **7**.

[0047] Such prior art systems therefore require at least duplication and in some cases triplication, or more, of the trunk **13** in order to provide appropriate connection to the multiple barriers **4**.

[0048] Turning now to the present invention, and the illustrated embodiment provided by FIG. **2**, it will be immediately apparent that only one connection to the trunk **23** is required. The provision of the trunk surge protector **22** and its flame proof connectors **29** advantageously provide for the sole interface to the trunk **23** that is required for feeding all of the barrier devices **24** illustrated in FIG. **2**.

[0049] Importantly, and as will be appreciated, the barrier devices **24** and indeed the surge protector **25**, trunk surge protector **22** and terminator **28** can likewise be readily removed and replaced in a plug-in/plug-out manner whilst maintaining the required degree of safety and without requiring any down-time for the system, nor gas clearance, and without requiring only specific manual operations other than removal and replacement of the modular barrier units **24**.

[0050] Turning now to FIG. **3** there is provided a plan view of a further embodiment of the present invention and similar reference numerals to those found previously are employed. Here, two (or it readily could be more) separate carriers **32** are provided each arranged for the removable mounting of two or more multi-spur barrier devices **24** and their associated spur surge protectors **25**.

[0051] Connection between the carriers **32** so as to effectively achieve a unitary back plane is achieved by way of a flameproof jumper **30** which is arranged for grouping connection by way of flameproof connectors **29** engaging with sockets within the carrier **32** and which could otherwise be occupied by a terminator **28**; one of which is illustrated in the right side carrier **32**.

[0052] Any appropriate number of carriers **32** can then be connected in series so as to provide for any appropriate number of spur outlets from the fieldbus barrier system of the present invention.

[0053] As a further advantage of the present invention, an appropriate degree of redundancy can be introduced into the system by operation of a selection of one of the modular fieldbus barrier units **24** as a redundant unit.

[0054] Such redundancy can readily be introduced into the present invention, and as illustrated in the embodiments of FIGS. **2** and **3**, in view of the modular nature of the fieldbus barrier units **24** in particular. Further, controlled-connectivity can be provided between the redundant unit **24** and the spur surge protectors **25** or spur outlets **10** associated with the failed barrier unit **24** as required.

[0055] The failed modular barrier unit **24** can then be readily and simply unplugged without requiring power down or gas clearance for thereby simple replacement by way of a replacement barrier unit.

[0056] As can be further appreciated, the surge protectors **22**, **25** of the invention can be readily replaced without effecting the whole operation of the system and the terminators **28** can be introduced, removed or replaced as appropriate during commission of the system whilst the system is live.

[0057] The modular nature of the barrier units **24** allows for replacement without the requirement for disconnecting any other barrier devices and the "plug and play" solution of the present invention greatly reduces the time that personnel need to be present on-site and any further extension to the system such as illustrated with reference to FIG. **3**, can be performed without requiring power down or gas clearance, and the ready introduction of an appropriate degree of redundancy likewise allows for live repair relevant within the system.

[0058] In particular the invention advantageously employs the use of flameproof connectors **29** rather than screw terminals as found in conventional systems, and indeed rather than the use of flameproof switches **3** as currently known.

[0059] The carrier **32** provides a simplified and secure alternative option as compared with the large amount of wiring arising in the current systems and the use of live pluggable surge devices without disturbance of the functionality of the system provides a further advantage as does the use of the carrier board or back plane device for the redundancy functionality of the system.

[0060] It should of course be appreciated that the invention is not restricted to the details of the foregoing embodiments and that any appropriate configuration of modular fieldbus barrier units and surge connectors, and indeed carrier boards can be provided as required and in offering an appropriate degree of Intrinsic Safety protection. Yet further, and with particular reference to FIG. **2**, while a total of sixteen spurs is provided by way of four barrier units **24** other configurations are readily possible. For example a single barrier unit could be provided which itself offers the sixteen output spurs, or two barrier units could be provided each offering eight output spurs. Any configuration is possible as required.

1. A multispur fieldbus barrier arrangement for connection to a trunk and in which each of a plurality of spurs is arranged to be connected to the trunk by way of a barrier device, wherein the barrier device comprises a removably mounted modular unit arranged for plug-in connection to the trunk by means of a flameproof connection.

2. An arrangement as claimed in claim **1**, wherein each modular unit includes plug-in connectors for connecting with surge protectors associated with the spurs.

3. An arrangement as claimed in claim **1** or **2**, wherein the modular barrier units are arranged to be mounted onto a support member within the arrangement.

4. An arrangement as claimed in claim **3**, wherein the support member comprises a carrier.

5. An arrangement as claimed in claim **4**, wherein the carrier comprises a back plane.

6. An arrangement as claimed in claim **3**, **4** or **5**, wherein the surge protectors are removably mounted within the arrangement.

7. An arrangement as claimed in any one or more of the preceding claims and including a trunk surge protector having flame proof connectors for providing an interface to the said trunk.

8. An arrangement as claimed in claim **7** wherein each of the barrier devices is connected to the trunk by way of the said interface.

9. An arrangement as claimed in claim **7** or **8**, wherein the said trunk surge protector device is removably mounted, having flameproof connectors.

10. An arrangement as claimed in any one or more of the preceding claims and including a redundant modular barrier device.

11. An arrangement as claimed in claim **10**, wherein the redundant modular barrier device is arranged for connection to the spur outlet associated with a failed barrier device.

12. An arrangement as claimed in claim **11**, wherein the redundant modular barrier device is arranged for the said connection to the spur in a manner responsive to the failure of the said failed unit.

13. An arrangement as claimed in claim **11** or **12**, and further including control means for configuring the said connection of the redundant modular barrier device to the spur outlets.

14. An arrangement as claimed in any one or more of the preceding claims and arranged for the receipt of removably mounted spur surge protector devices.

15. A fieldbus barrier device arranged to be removably mounted in a multispur fieldbus barrier system and between a trunk and spur outlets, the device including flameproof connector means for connection to the said trunk of the system.

16. A device as claimed in claim **15**, wherein the flameproof connector means comprise plug-connectors arranged for the removable mounting of the fieldbus barrier device.

17. A device as claimed in claim **15** or **16**, and including plug connector means for connection with surge protectors of the multispur fieldbus barrier system.

18. A device as claimed in any one or more of claims **15** to **17**, and arranged to be mounted by said flameproof connectors to support means of a multispur fieldbus barrier system.

19. A device as claimed in any one or more of claims **15** to **18** and comprising a modular readily removable plug-in device.

20. A multispur fieldbus arrangement substantially as hereinbefore described with reference to FIG. **2** and FIG. **3** of the accompanying drawings.

21. A fieldbus barrier device substantially as hereinbefore described with reference to and, illustrated in FIG. **2** and FIG. **3** of the accompanying drawings.

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