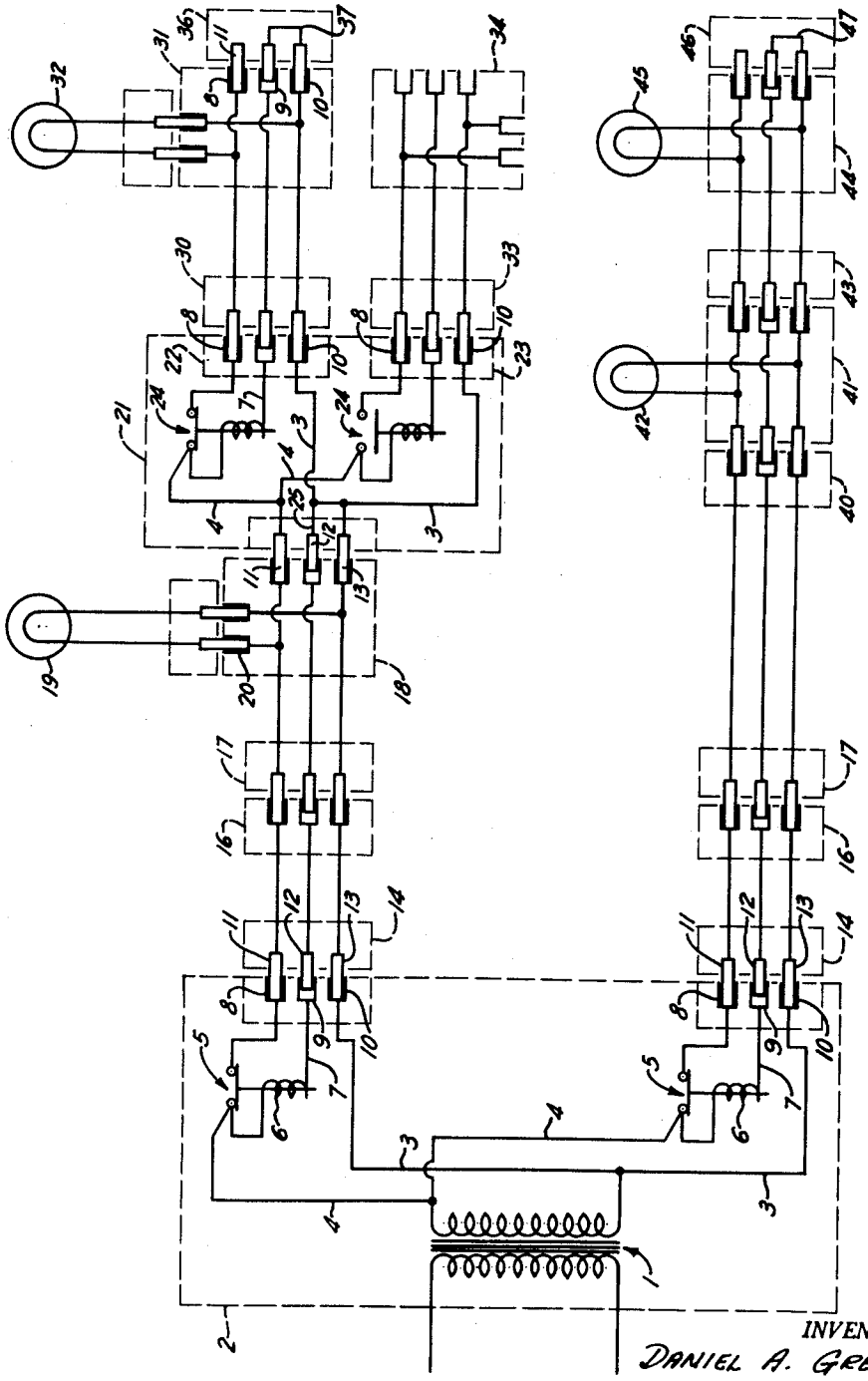
June 28, 1960 D. A. GREEN 2,943,213

ELECTRIC POWER SYSTEM FOR HAZARDOUS ATMOSPHERES

Filed March 5, 1957



INVENTOR.
DANIEL A. GREEN
BY
Brown, Critchlow, Flick & Peckham
HIS ATTORNEYS

United States Patent Office 2,943,213
Patented June 28, 1960

2,943,213

ELECTRIC POWER SYSTEM FOR HAZARDOUS ATMOSPHERES

Daniel A. Green, Pittsburgh, Pa., assignor to Mine Safety Appliances Company, Pittsburgh, Pa., a corporation of Pennsylvania

Filed Mar. 5, 1957, Ser. No. 644,112

7 Claims. (Cl. 307—112)

This invention relates to electric power systems for mines and other areas that may contain hazardous atmospheres which could be exploded by an electric spark.

One of the dangers associated with hazardous atmospheres, such as sometimes found in mines, is that an explosion may be set off by an electric spark from the electrical equipment or system used in the mine. It is therefore the practice to try to eliminate sparking or to confine it in such a way that it will not do any damage. These things are especially difficult to do when portable power equipment is used, which requires the insertion and removal of electric plugs at different locations in the mine. When a plug is separated from its socket, an arc is likely to be formed, which could ignite the surrounding atmosphere under the right circumstances.

It is among the objects of this invention to provide an electric power system which allows electrical elements to be plugged into and removed from various points in the circuit without dangerous sparks being formed, and without affecting electric power to other branches of the circuit.

According to this invention, two wires leading from a source of electricity in a safe location are adapted to be electrically connected to an electric lamp or other electrically energized object. One wire contains a switch that is normally open. Associated with the switch is a solenoid coil for closing it. One end of the coil is electrically connected to the side of the switch nearest the electric source, which will be referred to herein as the source side of the switch. A third wire is connected to the opposite end of the coil. The free ends of the three wires are connected to an electric socket having three contacts. There is a three prong plug for the socket and and electrical connection between the two prongs that engage the socket contacts that are connected to the third wire and the other wire that does not contain the switch. When the plug is in place, the circuit through the solenoid coil is completed and the coil is energized to close the switch. To make this a safe system, the engaging socket contact and plug prong that connect with the third wire are positioned to be disengaged from each other before the other prongs and contacts are disengaged, whenever the plug is removed from the socket. As a result, the circuit to the solenoid coil will be broken before the plug is totally withdrawn from the circuit and disconnected from the two wires connected with the lamp, so the switch will open the circuit to the lamp before the plug is disconnected from the wires connected to the lamp.

The preferred embodiment of the invention is illustrated in the accompanying diagramatic drawing of my system.

Referring to the drawing, a suitable source of electricity includes a transformer 1 enclosed in a housing 2. The housing can be sealed, although generally it will not be taken into a hazardous atmosphere in a mine or the like, but will be left in the fresh air outside. Extending away from the opposite ends of the secondary of the

transformer are one or more wires, depending on how many outlets the housing is to have. The one in the drawing is shown with two outlets. Two wires 3 lead away from one end of the transformer secondary. Each of two wires 4 from the opposite end of the secondary contains a normally open electric switch 5, to the source side of which one end of a solenoid coil 6 is connected. A third or control wire 7 is connected to the opposite end of the coil. When the coil is energized, it will close the switch. The control wire and a wire from each end of the transformer secondary have their outer ends close together, where they are connected to three electric socket contact members 8, 9 and 10 at one side of housing 2. These mebers frictionally receive the three prongs 11, 12 and 13 of a plug 14. Three wires, which are merely extensions of wires 3, 4 and 7 extend away from the three prongs and into the mine, where they are also connected to the contacts of an electric socket 16, likewise adapted to receive a three-prong plug 17. There may be as many plugs and sockets and connecting wires between them as desired.

In the upper half of the drawing the wires from plug 17 are shown extending into a socket 18, to which an electric lamp 19 or other piece of electrical equipment is connected. The lamp is shown plugged into a pair of socket contacts 20 connected to the two outer wires 3 and 4 which lead to the opposite ends of the transformer. Therefore, when switch 5 is closed, the lamp will be lit. To complete the control circuit through the switch coil, the control wire 7 is electrically connected at socket 18 with the prongs 12 and 13 that plug into the two socket contacts connected with wires 7 and 3, respectively. These two plugs are connected electrically in a manner soon to be described. Consequently, when the prongs are removed, the control circuit through the solenoid will be broken and the switch 5 in the main circuit will be opened to extinguish the lamp.

To increase the number of electrical lines that can be used, a branch line sealed box 21 can be plugged into any one of the sockets. It is shown plugged into socket 18. This box has at least two outlet sockets 22 and 23. Wires 3 connected to contacts 10 of the two sockets are connected to prong 13 projecting from the box, while wires 4 connected to socket contacts 8 are also connected to prong 11. The last two wires contain normally open solenoid switches 24 operated in the same way as the switches described before. The center prong 12 of the box is connected by a short wire 25 with wires 3 in the box, thereby electrically connecting prongs 12 and 13 to complete the control circuit as indicated in the preceding paragraph.

A branch line plug 30 is plugged into socket 22 and is connected by three wires with a socket 31 like socket 18. An electrtic lamp 32 is plugged into socket 31. Another plug 33 engages socket 23 and is connected by three wires with a socket 34 also adapted to receive a lamp or other electrically operated device. Lamps 19 and 32 are low power (½ ampere or less) devices.

As the main circuit to lamp 32 cannot be closed until switch 24 in that circuit is closed, it is necessary to electrically connect contacts 9 and 10 of socket 31 for that purpose. This is done by means of a removable energizing plug 36 that preferably is provided with three prongs, the same as the other plugs, although it is not absolutely necessary that there be three prongs because the prong 11 that engages socket contact 8 is a dummy. The other two prongs are connected together by a short wire 37 to complete the control circuit for switch 24.

In the lower half of the drawing, plug 17 is shown connected to a socket 40, to which is connected a combined plug and socket 41 that has an electric lamp 42

permanently connected to it. When the lamp burns out, the entire unit is replaced because this lamp represents a device that draws more current than lamp **19** and it therefore would be dangerous to use a plug-in connection for it. If it is desired to remove the lamp from the circuit, the combined plug and socket **41** is removed and a plug **43**, which was plugged into it, is then plugged directly into socket **40**. Plug **43** may be electrically connected to another socket **44**, the one illustrated being permanently connected to a lamp **45**. To complete the control circuit of this branch of the system, an energizing plug **46** is plugged into socket **44**. The center prong and the one connected with wire **3** are joined by a short wire **47**. It will be seen that when this plug is removed, the control circuit is opened so that switch **5** will open the main circuit.

It is a feature of this invention that when any plug is separated from its socket there will be no arcing at the prongs connected with the main circuit wires **3** and **4**. Except where low load device **19** or **32** is to be disconnected, which will not cause dangerous sparking anyway, this is accomplished by first breaking the control circuit to the solenoid switch head of the plug being removed, so that the main circuit will be opened at that switch before prongs **11** and **13** of that plug leave socket contacts **8** and **10**. The switch coil circuit is opened before the main circuit by so positioning, in the plug and socket being separated, the engaging center contact and prong in the control circuit that the prong will become disengaged before the other two prongs and contacts are separated as the plug is pulled away from the socket. Although this can be accomplished by terminating the outer end of center contact **9** behind the other two contacts, so that the center prong of the plug will separate from it before the outer prongs leave their contacts, it is preferred to make all of the socket contacts alike and to use a short center prong **12** for the plug. In either case, it will be seen that when the plug is inserted in the socket, the outer prongs will engage their contacts before the center prong meets the center contact. Conversely, when the plug is removed, the center prong will leave its contact first, thereby opening the control circuit so that the switch will open the main circuit before the main circuit is broken at the plug and socket. The main circuit consequently cannot produce an arc. Dangerous open sparking does not occur when the control circuit is opened, because the switch coil draws very little current, preferably only about one-half ampere. This electrical system therefore is safe to use in explosive atmospheres, with push-pull industrial connectors.

It will be seen that in this system any branch circuit can be disconnected without interrupting power to the other branches. For example, whether the lower switch **24** in box **21** is open or closed has no effect on the circuit to lamps **19** and **32** or to the circuit to lamps **42** and **45**. Also, even if energizing plug **36** is removed, current still will be supplied to lamp **19** and to lamps **42** and **45**.

According to the provisions of the patent statutes, I have explained the principle of my invention and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. In an electric power system, a source of electric current, two wires leading from said source and adapted to be electrically connected to a load, a normally open switch in one wire, a solenoid coil for closing the switch and having one end electrically connected to the source side of the switch, a third wire connected to the opposite end of the coil, an electric socket having three contacts connected to the free ends of the three wires, a three prong plug for the socket, and means electrically connecting the two prongs that engage the socket contacts that are connected to said third wire and the other wire that does not contain said switch, whereby to energize the coil and close the switch, the engaging socket contact and plug prong that connect with said third wire being positioned to be disengaged from each other before the other prongs and contacts are disengaged when the plug is removed from the socket.

2. In an electric power system, a source of electric current, two wires leading from said source and adapted to be electrically connected to a load, a normally open switch in one wire, a solenoid coil for closing the switch and having one end electrically connected to the source side of the switch, a third wire connected to the opposite end of the coil, an electric socket having three contacts connected to the free ends of the three wires, a three prong plug for the socket, and means electrically connecting the two prongs that engage the socket contacts that are connected to said third wire and the other wire that does not contain said switch, whereby to energize the coil and close the switch, the engaging socket contact and plug prong that connect with said third wire being spaced apart when the other two prongs first engage the other two contacts, whereby when the plug is separated from the socket the first-mentioned plug and contact will separate first and break the circuit to said coil.

3. In an electric power system, a source of electric current, two wires leading from said source and adapted to be electrically connected to a load, a normally open switch in one wire, a solenoid coil for closing the switch and having one end electrically connected to the source side of the switch, a third wire connected to the opposite end of the coil, an electric socket having three contacts connected to the free ends of the three wires, a three prong plug for the socket, and means electrically connecting the two prongs that engage the socket contacts that are connected to said third wire and the other wire that does not contain said switch, whereby to energize the coil and close the switch, the plug prong that engages said third wire contact in the socket being shorter than the other two prongs so that when the plug is removed said prong will break the circuit to said coil before the other two prongs are disconnected from the other two contacts.

4. In a power system according to claim 1, said socket also being provided with a pair of contacts for receiving the prongs of a plug-in device drawing at least as little current as said coil, said pair of contacts being electrically connected with said two wires.

5. In a power system according to claim 1, an electrical load permanently connected to said two wires in said socket.

6. In a power system according to claim 1, in which the plug is also provided with three contacts electrically connected to its prongs, said last-mentioned contacts being adapted to be engaged by the prongs of a plug similar to said first-mentioned plug, and an electrical load is permanently connected with said other prongs of the first-mentioned plug.

7. In an electric power system, a source of electric current, two wires leading from said source and adapted to be electrically connected to a load, a normally open switch in one wire, a solenoid coil for closing the switch and having one end electrically connected to the source side of the switch, a third wire connected to the opposite end of the coil, an electric socket having three contacts connected to the free ends of the three wires, a three prong plug for the socket, means electrically connecting the two prongs that engage the socket contacts that are connected to said third wire and the other wire that does not contain said switch, whereby to energize the coil and close the switch, the engaging socket contact and plug prong that connect with said third wire being positioned

to be disengaged from each other before the other prongs and contacts are disengaged when the plug is removed from the socket, the plug being in the form of a box provided with a plurality of groups of three socket contacts, wires connecting said other prongs to two of said box contacts in each group, a normally open switch in one wire of each group, a solenoid coil for closing each switch in the box and having one end connected to the source side of that switch, a third wire connected to the opposite end of each coil and to the third contact in the adjacent group, a three prong plug for each of said groups of box contacts, and means electrically connecting the two prongs of each of those plugs that engage

the box contacts that are connected to one of said third wires and the adjacent wire that does not contain a box switch, whereby to energize the box coils and close the switches therein, said box sockets and engaging plugs being similar in operation to said first-mentioned socket and plug.

References Cited in the file of this patent

UNITED STATES PATENTS

1,593,711	Farmer	July 27, 1926
1,908,985	Kennedy	May 16, 1933
2,424,812	Gallaher	July 29, 1947