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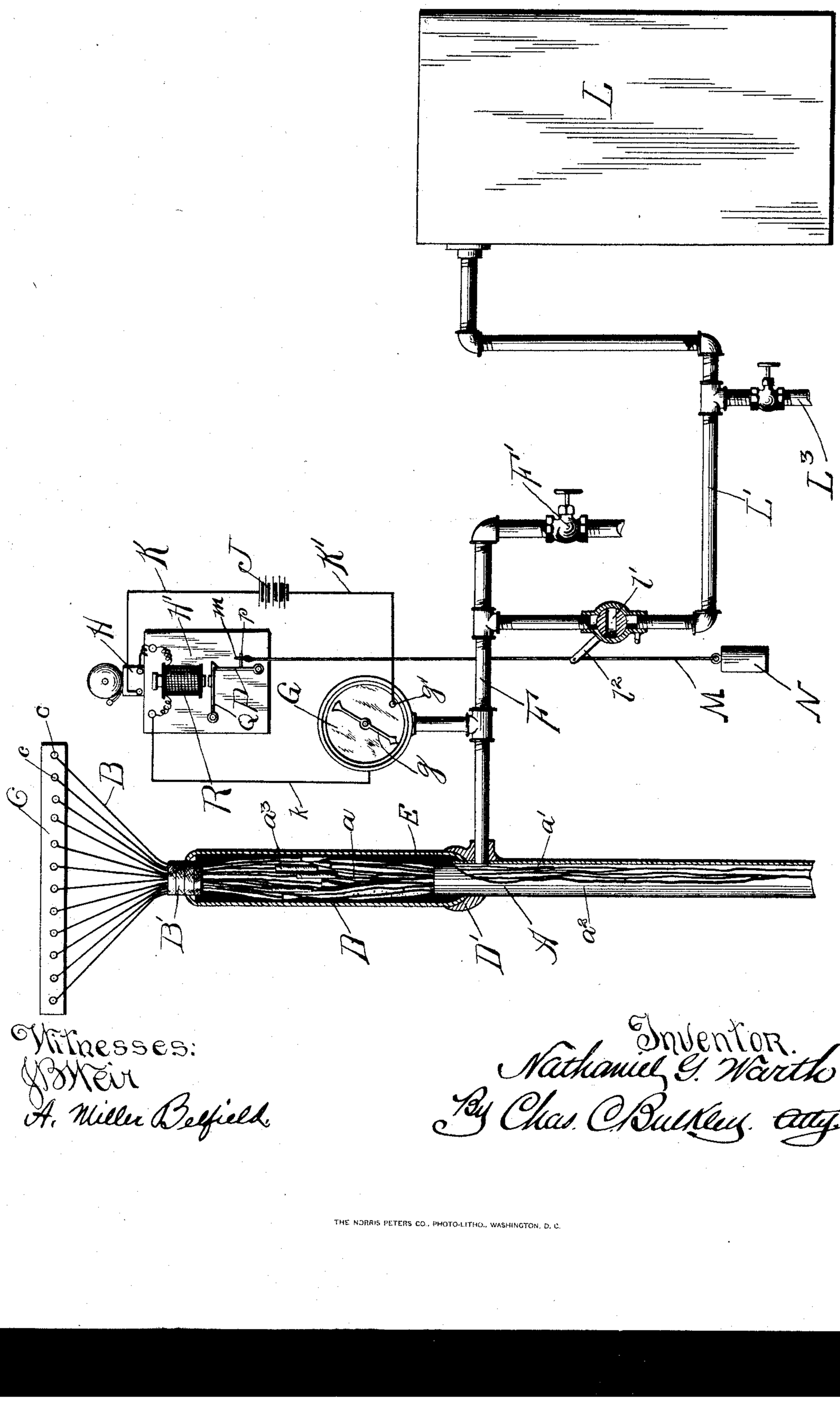
N. G. WARTH.

ELECTRICAL DEVICE INVOLVING HERMETICALLY INCASED CONDUCTORS.

(Application filed Dec. 7, 1897.)

(No Model.)



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UNITED STATES PATENT OFFICE.

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ELECTRICAL DEVICE INVOLVING HERMETICALLY-INCASED CONDUCTORS.

SPECIFICATION forming part of Letters Patent No. 621,001, dated March 14, 1899.

Application filed December 7, 1897. Serial No. 661,107. (No model.)

To all whom it may concern:

Be it known that I, NATHANIEL G. WARTH, a citizen of the United States, residing at Indianapolis, in the county of Marion and State of Indiana, have invented a certain new and useful Electrical Device Involving Hermetically-Incased Conductors, of which the following is a specification.

My invention relates to electrical devices involving in their construction one or more electrically-insulated conductors or conductor-sections and depending for a high degree of efficiency largely upon the possession by their insulating media or dielectrics of a low specific inductive capacity or a high specific resistance or a high dielectric strength or upon two or all three of these characteristics—such devices, for instance, as induction-coils, converters, condensers, telegraph and telephone cables, and the like.

Prominent objects of my invention are as follows, to wit: to reduce to a minimum the electrostatic capacity of such devices and to increase to a maximum the specific resistance and dielectric strength of their dielectrics; to allow such reduction in electrostatic capacity and increase in specific resistance and dielectric strength to be secured without necessitating an accompanying objectionable variation in the size, form, or construction of the devices; to prevent, so far as possible, sparking or flashing across the dielectric and also to prevent the combustion of the latter and the generation of expansive or explosive gases; to render practically impossible the composition of the dielectric being so altered as to permit it either to maintain a spark or support combustion; to arrange for the automatic notification of attendants of the creation of conditions which would impair the efficiency of the dielectric and also for the automatic prevention of such impairment after the creation of such conditions and until the attendants have opportunity to remove, adjust, or repair the same, and to attain such results in a simple, practical, inexpensive, effective, and highly-efficient manner.

In a device of the class specified characterized by my invention the dielectric is composed in part of air or like gas in a rarefied condition. As a result its specific inductive capacity is reduced and its specific resistance increased, for the reason that the specific inductive capacity of rarefied air is less and the specific resistance thereof greater than the corresponding properties of any other known substance or materials. As a further result the liability of combustion within the device is materially reduced by the extraction of a greater or less proportion of the oxygen which would otherwise support it. As a preferred arrangement the rarefied air forming the dielectric is rarefied to the highest possible degree—that is to say, so as to form thereof the nearest possible approximation to an absolute vacuum. In this way the specific inductive capacity of the dielectric is reduced to an absolute minimum and the specific resistance thereof increased to an absolute maximum, while at the same time the dielectric strength of the same is also increased to a maximum. In this way also the liability of combustion and the danger of such an alteration in the composition of the dielectric as to cause the same either to act as a conductor, or to generate explosive or expansive gases, or to maintain a spark, or to support combustion are practically removed by reason of the substantial absence of oxygen from within the device.

All of the above advantages, it will be observed, can be secured without objectionably increasing the size or varying the form or construction of the device.

In carrying out my invention I confine the insulated conductors within an impermeable and hermetically-sealed hollow or chambered conductor-holder—such, for example, as the tubular metallic sheath or casing of a telephone or telegraph cable—and then exhaust from the interior of such hollow holder substantially all of the air lying in the otherwise unoccupied space or spaces within it and between the conductors themselves or between the same and the interior walls of the holder, or both.

Obviously devices of the class specified now in use and involving in their construction a mass of porous and fibrous insulation—such, for instance, as hygroscopically-insulated electric cables—can have my invention applied to them by making them hermetically

tight, if they are not already so constructed, and then exhausting substantially all the air from within them.

In this application I show my invention applied to an electric cable, such as a telephone or telegraph cable, involving in its construction a plurality of longitudinally-disposed insulated conductors and an impermeable and hermetically-sealed lead or other metallic pipe in which the conductors and the insulation therefor are confined. In view of the foregoing, however, it will be readily seen that my invention can be applied to any and all of the devices of the class specified. Therefore I do not wish to limit myself to its application to an electric cable, but consider that it is applicable to any and all devices of the class specified. In connection with this said cable I have shown means for indicating a condition of permeability of the cable-sheath, which condition would of course permit an impairment of the cable-dielectric by the admission of the external atmosphere or other surrounding medium, and also means for notifying the attendant of the creation of such condition and for temporarily preventing the resulting impairment of the dielectric until such condition can be removed or repaired by the attendants. Such means can of course be used in connection with any device of the class specified.

In the accompanying drawing the figure is an electric cable embodying my invention and an apparatus for indicating and notifying attendants of the creation of a condition of permeability of the sheath thereof and also for automatically preventing the impairment of the dielectric by the admission of the external air or other surrounding medium upon the creation of such condition.

The cable A shown comprises a plurality of longitudinally-disposed conducting-wires a a, a mass of solid insulating material a', in which the conductors a a are embedded, and a metallic sheath or covering a^2, which incloses the conductors a a and the insulating material a'. This insulating material could be fibrous material, such as jute-cotton, and this material could be either in the dry state or be treated with any well-known insulating compound or oil to increase its insulating capacity, or it could be of any well-known rubber compound or any other suitable insulating material; but as a preferred construction it is untreated or dry fibrous material, for such material has itself a less specific inductive capacity than the heavier materials and so gives the cable a less specific capacity than would be given by the latter, other things being equal, while at the same time it is more porous and so affords more and larger spaces which can contain the rarefied air or like gas.

The ends of the cable can be hermetically sealed, so as to prevent the admission of the surrounding medium into the cable-sheath and at the same time to allow the ends of the cable-conductors to be connected up for service in any suitable way. As a preferred arrangement, however, they are thus sealed by an improved cable-terminal, which is shown and claimed in Letters Patent No. 603,069, granted and issued to me April 26, 1898. Inasmuch as said terminal is fully illustrated and described in my said patent I shall refer to it herein only briefly. In it the ends of the cable-conductors a a are allowed to protrude from the end of the cable-sheath a^2 and are connected by suitable connections a^3 with a plurality of non-hygroscopically-insulated conductors B B, which latter are suitably connected up for service—as, for example, to contacts c c on a switchboard C. The protruding ends of the cable-conductors a a, the ends of the service-wires B B, connected thereto, and the connections a^3 a^3 between the former and the latter are then confined in an impermeable, preferably metallic, sleeve D, which is slipped a short distance over the end of the cable-sheath a^2 and is secured thereto by a hermetically-tight joint—as, for instance, the wiped joint D'. The sleeve D is next substantially filled with a sealing material E, such as beeswax or asphaltum compound in a molten condition, so that the conductor portions and connections are hermetically embedded therein and the sealing material allowed to cool and harden, and finally the end of the sleeve D, which the service-conductors B B enter, is closed about the latter at a point where the same are assembled into a compact core, as at B'. This cable-terminal can of course be used in connection with any form of cable and when so used possesses many decided advantages, as fully set forth in my other said application. As a preferred arrangement the cable end and the sleeve D are secured permanently for service in an upright or substantially vertical position, as shown in the drawing, in which case the sealing material E is prevented from oozing or running out should it become heated sufficiently to melt it.

The air within the interior of the cable-sheath a^2 could be substantially exhausted therefrom, so as to create a substantial vacuum in the otherwise unoccupied space thereof, in any suitable or preferred way. In the arrangement shown it is exhausted by way of a valved exhaust-pipe F, attached to the cable-sheath a^2 near the end of the latter and understood to be connected at a point beyond its valve F' with a suitable exhaust-pump. (Not shown in the drawing.) After the air within the sheath has been sufficiently exhausted therefrom the valve F' is closed and the exhaust-pump stopped or disconnected. The extent to which the air has been exhausted from within the sheath, or, in other words, the degree of rarefaction of such air can be indicated by a suitable pressure-gage G, adapted to indicate a degree of air-pressure and conveniently attached to the exhaust-pipe F between its exhaust-valve F' and its connection with the cable-sheath a^2.

The hand g of the gage indicates by its position the air-pressure within the sheath. Whether or not the cable-sheath is and remains impermeable is also indicated by the gage G. If the pointer g thereof remains stationary, it indicates a condition of impermeablility of the cable-sheath; but if it moves back toward the point or figure indicating the normal atmospheric pressure it indicates the admission of the surrounding medium, and consequently the permeability of such sheath. I desirably make suitable provision for automatically notifying the attendants upon the creation of such a condition of permeability of the cable-sheath. As a simple arrangement an electric alarm H, mounted upon a suitable base or support H', and a battery J are included in an electric circuit K, which latter is connected with the gage G in such a manner as to cause the bell H to ring when the pointer g of the gage indicates the existence of normal atmospheric or any other predetermined pressure within the cable-sheath. The circuit K is thus connected with the gage G by terminating one side k thereof at the metallic case of the gage and the other side K' at a contact g', adapted to make connection with the pointer g and situated on the face or dial of the gage at the point indicating the normal atmospheric or other predetermined pressure. By such arrangement the movement of the pointer g into contact with the contact g' closes the circuit K, and thereby automatically causes the bell H to be rung.

As an arrangement for automatically maintaining the permanency of the cable dielectric after the creation of a condition of permanency of the cable-sheath until the attendants can obviate such condition dry compressed air is upon the creation of such condition automatically admitted into the interior of the cable-sheath, so as to cause the same to occupy the spaces and interstices previously occupied by the rarefied air. In this way the external air or other surrounding medium is excluded from the interior of the cable-sheath, and consequent injury to the dielectric of the cable thus prevented, until the pressure of the dry compressed air is reduced to normal atmospheric pressure by a portion thereof escaping through the cable-sheath. However, inasmuch as impairments to the impermeability of cable-sheaths are usually very slight some time will elapse before such a reduction of the pressure of the compressed air is effected, and so the attendants will have considerable time in which to make repairs. As a simple and effective arrangement the compressed air so admitted is stored preparatory to admission in a suitable tank or reservoir L and is automatically admitted into the cable-sheath a^2 upon the impairment of the latter by way of a supply-pipe L', connected to the reservoir H and to the exhaust-pipe F at a point between the valve F' of the latter and the connection thereof with the cable-sheath a^2. This pipe L' is provided with a valve l', which is normally closed, so as to normally prevent the compressed air in the tank L from passing into the interior of the cable-sheath a^2, and is automatically opened upon the impairment of such sheath. As a simple arrangement for thus automatically opening the valve l' the valve-lever l^2 has attached to it a normally-suspended and automatically-released rope or cord M, carrying a weight N, so that when the cord M is automatically released the weight N draws it downward and depresses the valve-lever l^2 and opens the valve l'. The cord M is normally held in suspension by the engagement of an eye or ring m on its upper end with a pin p, which extends laterally from a vertically-swinging pivoted lever P, and is automatically released by the sliding of such eye or ring m from the pin p when the pivoted lever P is unlocked and allowed to swing downward. The vertically-swinging lever P' is locked in vertical position by a pivotally-supported catch Q, pivoted to the base H' and constructed at its outer end with a hook which engages the upper end of the swinging lever P and so prevents the weight N from drawing such lever downward. The pivotal catch Q normally rests in horizontal position upon the upper end of the swinging lever P when its hook is in engagement therewith. It is automatically lifted, so as to release the lever P and thereby allow the weight N to drop and close the valve l, by an electromagnet R, which is mounted on the base H' and which is included in the circuit K and so is energized upon the movement of the gage-hand g into contact with the contact-piece g'. In this way the creation of a condition of permanency of the cable-sheath will simultaneously and automatically both notify the attendants by ringing an alarm-bell and maintain the permanency of the cable insulation until the imperfection in the cable-sheath can be permanently repaired. After such repairment the supply of dry compressed air can be shut off and the air within the cable-sheath again exhausted.

After the cable has been repaired and the air again exhausted therefrom the compressed-air tank or reservoir can be recharged by way of a valved supply-pipe L^3, attached to the pipe L' and understood to be connected with a suitable source of compressed air, which can be operated to fill the tank. Of course, if convenient, the tank L can be omitted altogether and an operative source of compressed air connected directly to and controlled so as to discharge automatically into the cable-sheath in the manner described in connection with the tank L.

It is obvious that where a plurality of cables are terminated at the same point each one can be provided with a separate pressure-gage, and these gages can be suitably mounted for inspection upon a single switch-board. It is also obvious that the alarm-bell and compressed-air-supplying arrangements

can be employed in connection with cables or the like containing air under pressure instead of rarefied air. In such latter case it is only necessary to fix the contact g' on the gage-dial at the point indicating any predetermined pressure.

Having thus described my invention, what I claim as new therein, and desire to secure by Letters Patent, is—

1. In an electric cable, an impermeable and hermetically-sealed sheath containing fibrous insulating material and rarefied air which latter in part forms the dielectric for the conductors when the cable is in use.

2. The combination of a device involving in its construction one or more insulated conductors or conductor-sections, and an impermeable and hermetically-sealed hollow holder which incloses the conductors or conductor-sections, and which contains air or like gas under a pressure other than the normal atmospheric pressure; and means for automatically notifying the attendants of the impairment of the impermeability of the hollow holder, as set forth.

3. The combination of a device involving in its construction one or more insulated conductors or conductor-sections and an impermeable and hermetically-sealed hollow holder which incloses the conductors or conductor-sections, and which contains air or like gas under a pressure other than the normal atmospheric pressure; a pressure-indicating gage connected so as to indicate the degree of pressure within the hollow holder; and an electric circuit provided with an alarm-bell and a battery, and connected with the gage so as to cause the bell to be rung at a time when the gage indicates a predetermined pressure, as set forth.

4. The combination of an electric cable having a normally imperforate and hermetically-sealed sheath containing rarefied air; a pressure-indicating gage having a swinging pointer and an electric contact adapted to make connection with the pointer and situated at a point indicating a pressure other than the normal pressure within the sheath; and an electric circuit provided with an alarm-bell and a battery, and connected with the gage-pointer and contact so that when the former moves into contact with the latter the circuit is closed and the bell rung, substantially as described.

5. The combination with a device involving in its construction one or more insulated conductors or conductor-sections, and an impermeable and hermetically-sealed hollow holder which incloses the conductors or conductor-sections, and which contains air or the like under a pressure other than the normal atmospheric pressure; and means for automatically preventing the admission of the external air or other surrounding medium upon the creation of a condition of permeability on the part of the hollow holder, as set forth.

6. The combination with a device involving in its construction one or more insulated conductors or conductor-sections, and an impermeable and hermetically-sealed hollow holder containing the same and also containing air under a pressure other than the normal atmospheric pressure; means for supplying dry compressed air; and means for automatically admitting such air into the interior of the hollow holder upon the creation of a condition of permeability thereof, as set forth.

7. The combination with a hollow impermeable and hermetically-sealed conductor-holder containing one or more conductors or conductor-sections, and also containing air or the like under a pressure other than the normal atmospheric pressure; of a pressure-indicating gage connected with the hollow holder so as to indicate the pressure therein, means for supplying dry compressed air; a valved supply-pipe extending from such means to the hollow holder; a weighted cord attached to the supply-pipe valve-lever so as to depress the same and open the valve when free to descend; a pivotally-supported swinging lever having a laterally-extending arm or projection adapted to engage a ring at the end of the weighted cord, and thereby normally hold such cord in suspension; a swinging catch normally engaging the swinging lever so as to hold the same in position to retain the lateral arm thereof and said ring in engagement; an electromagnet adapted when energized to actuate the swinging catch in a way to disengage the same from the swinging lever, and thereby allow the latter to swing and the weighted cord to descend and open the supply-valve; and an electric circuit including the electromagnet and connected with the pressure-gage so as to be closed upon the indication thereby of any predetermined pressure, substantially as described.

8. The combination with a hollow impermeable and hermetically-sealed conductor-holder containing one or more conductors or conductor-sections and also containing air or the like under a pressure other than the normal atmospheric pressure; of means for automatically notifying the attendants of the creation of a condition of permeability of the hollow holder; and means for temporarily preventing the admission of the external air or other surrounding medium into the holder after the creation of such condition as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

NATHANIEL G. WARTH.

Witnesses:
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