Feb. 2, 1937. R. C. HYDE 2,069,250

SAFETY DEVICE FOR HIGH POTENTIAL ELECTRICAL CIRCUITS

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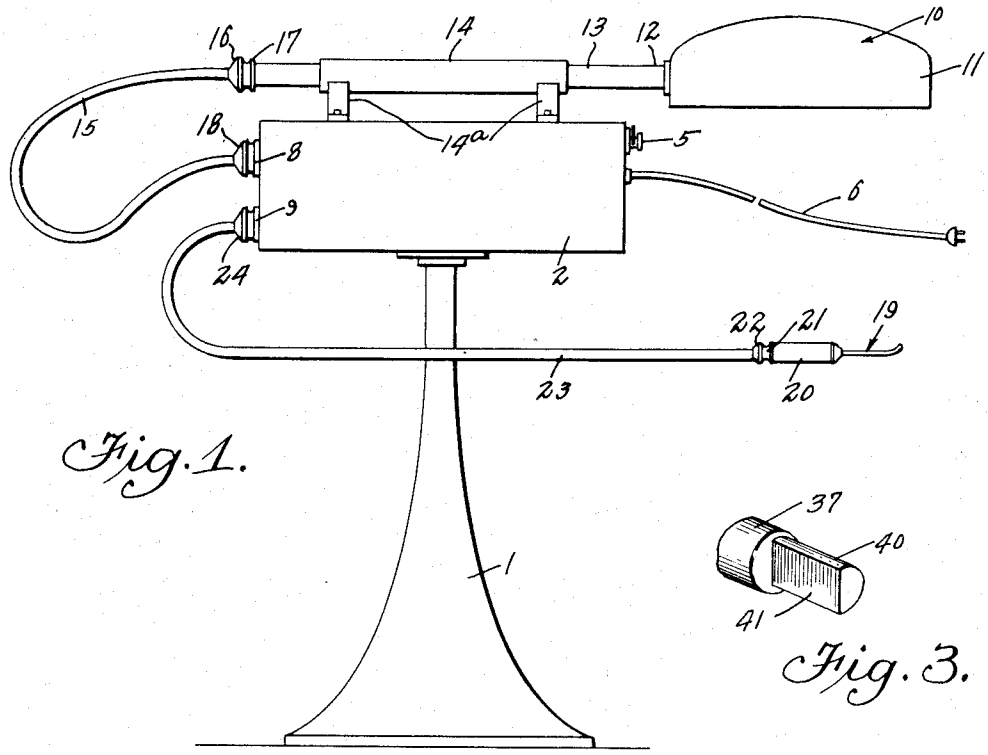
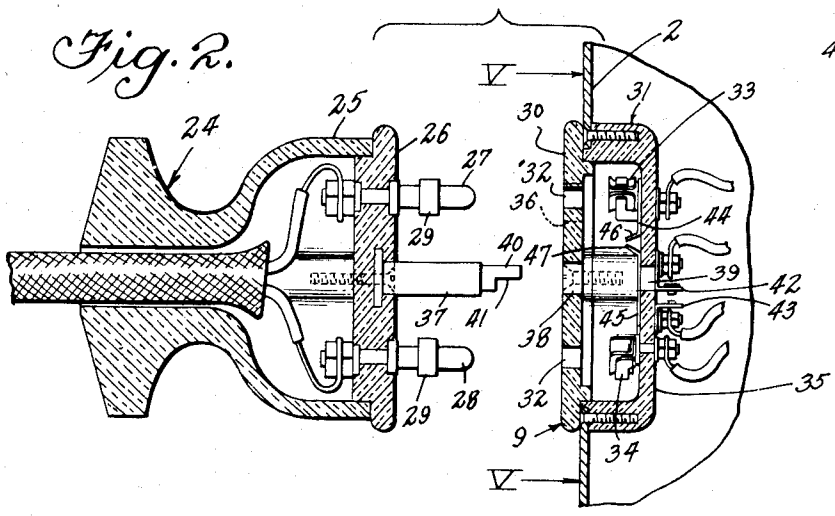


Fig. 1.

Fig. 3.

Fig. 2.



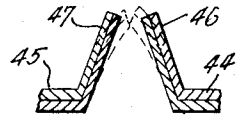


Fig. 4.

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Fig. 5.

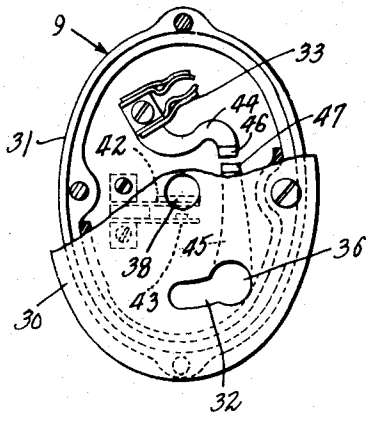


Fig. 6.

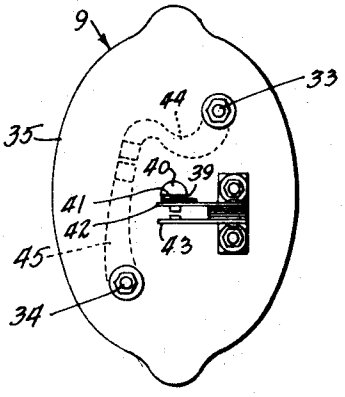
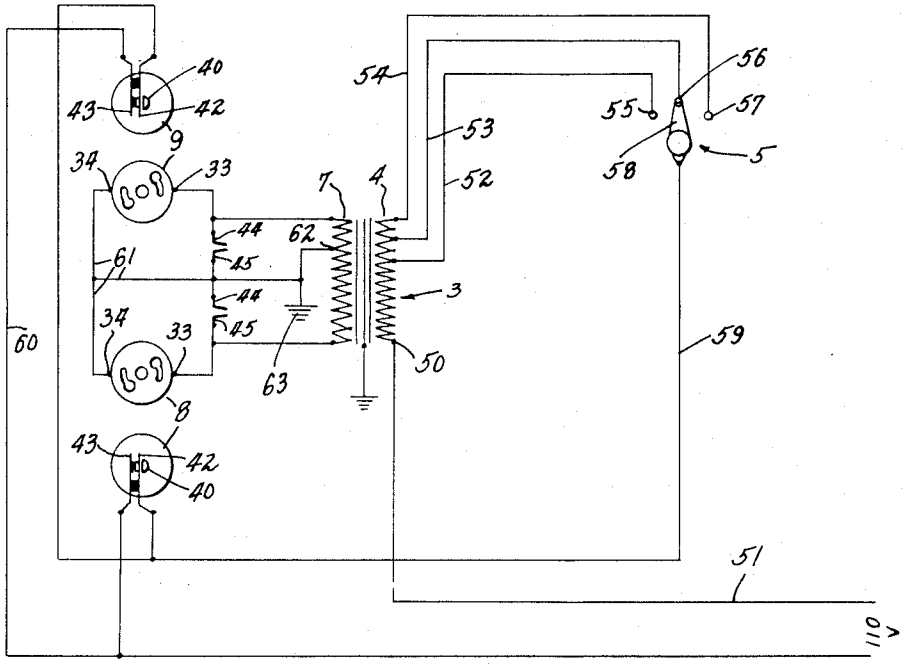


Fig. 7.



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Patented Feb. 2, 1937 2,069,250

UNITED STATES PATENT OFFICE

2,069,250

SAFETY DEVICE FOR HIGH POTENTIAL ELECTRICAL CIRCUITS

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Application December 5, 1933, Serial No. 700,979

1 Claim. (Cl. 200—118)

My invention relates to electrical apparatus employing high potential electrical current, and has particular reference to a safety device which may be employed to limit the length of the arc which may be drawn in such circuits.

In certain types of high potential electrical apparatus, such as electrotherapeutic lamps, it is common practice to employ high potential current to the electrical apparatus through flexible conductors, and to use plug type connectors for the purpose of connecting the electrical apparatus with a suitable source of high potential electrical supply. This is particularly true in apparatus such as is commonly employed for the production of ultraviolet ray emanations for the purpose of treating the human body, such apparatus usually incorporating a transformer, the primary winding of which is connected to a suitable source of low voltage supply, while the secondary winding of which is arranged to be connected to suitable receptacles into which may be plugged flexible conductors leading high potential current to the lamps or other devices which are employed for producing the ultraviolet ray emanations. When any of such plug connections are used there is danger that some person handling the machine will inadvertently remove the plug from the receptacle without first disconnecting the low voltage from the transformer, or without first opening the primary winding circuit for the transformer and in such instance the high potential current will tend to arc between the terminals in the receptacles and the terminals upon the plug, thereby exposing the person handling the machine to severe shocks and burns from such arcs.

It is, therefore, an object of my invention to provide a safety device which may be readily incorporated in the circuit connections of the transformer and electrical apparatus which will insure that in disconnecting the lamp or other electrical apparatus on the high potential side of the transformer it will automatically result in a definite and positive limitation of the length of arc which may be drawn and that such arc will be limited to such short distance as to prevent any injury to the person handling the machine.

Another object of the invention is to provide a device for automatically limiting the arc which can be drawn on the high potential side of the transformer.

Another object of the invention is to provide a device for automatically limiting the length of the arc which may be drawn on the high potential side of the transformer and which will automatically short-circuit the high potential winding of the transformer as soon as any arcing condition arises.

Another object of my invention is to provide a device as set forth in the preceding paragraph in which such device will automatically maintain the high potential side of the transformer short-circuited during the entire time that conditions exist which might result in arcing.

Other objects and advantages will be apparent from a study of the following specifications, read in connection with the accompanying drawings, wherein

Figure 1 is an elevational view of an electrotherapeutic lamp wihch may be employed in the practice of my invention;

Fig. 2 is an exploded sectional view of a plug and receptacle connection which may be employed in the practice of my invention;

Fig. 3 is a detailed view of a switch operating element which may be employed in the practice of my invention;

Fig. 4 is a detail sectional view of a spark gap which may be employed with my invention;

Fig. 5 is a plan view of a receptacle which may be employed for connecting and disconnecting electrical apparatus in accordance with my invention;

Fig. 6 is a plan view of the rear plate of the receptacle shown in Fig. 5;

Fig. 7 is a diagrammatic view illustrating a wiring system which may be employed with my invention; and

Fig. 8 is a diagrammatic view illustrating the modified form of my invention.

Referring to the drawings, I have illustrated one form of electrical apparatus which employs a high potential electric current for its operation, such apparatus being shown herein as in the form of an electrotherapeutic lamp commonly employed by physicians and in hospitals for the purpose of irradiating portions of the human body with ultraviolet rays. Such apparatus is illustrated as including a suitable stand or base 1 upon the upper end of which is mounted a box-like housing 2 containing a transformer 3, the primary winding 4 of which may be connected through a suitable switch 5 and a flexible cable 6 to a suitable source of low voltage electric current such as the usual 110-v. supply lines commonly employed for the distribution of electric current.

The secondary winding 7 of the transformer is illustrated as being connected to a pair of elec-

trical receptacles 8 and 9 which will permit the connection therewith of various types of ultraviolet ray generators which will employ the high potential electric current for their operation.

I have illustrated one form of such ultraviolet ray generator including what is known as a body burner 10 which may be of any well-known construction, usually surrounded by and supported by a hood or reflector 11 rigidly mounted upon one end 12 of a tubular bracket 13 which in turn is slidably mounted in a tubular support 14 secured upon brackets 14a mounted upon the upper side of the transformer housing 2. Such mounting permits the sliding of the burner 10 longitudinally relative to the transformer housing 2, and also permits the same to be rotated along the axis parallel to the major axis of the transformer housing 2 to adjust the body burner to any desired position to direct the ultraviolet rays produced thereby to any desired portion of the human body to be treated.

In view of the fact that it is necessary to adjust the position of the burner 10, it is desirable that the high potential electric current for the burner be supplied through a suitable flexible cable or conductor 15 and that such cable be connected to the burner by a detachable connector or plug connection 16 which may be received in a suitable receptacle 17 mounted upon the end of the tubular bracket 13, while the opposite end of the cable 15 is provided with a suitable plug 18 receivable in either the receptacle 8 or the receptacle 9 mounted upon the transformer housing 2.

I have also illustrated a second type of burner which may be employed for the treatment of certain portions of the body, this apparatus being illustrated as an orificial burner 19, the lamp of which constitutes an elongated narrow tube for producing the ultraviolet rays which is mounted in a suitable handle 20, one end of which is provided with a plug connection 21 receivable in a suitable receptacle 22, to which is secured a flexible cable 23 the opposite end of which is provided with a plug connection 24 insertable in and connectible with the receptacle 8 or 9 on the transformer housing 2.

The particular form of plug and receptacle connector which can be employed for connecting the high potential side of the transformer with the various burners, may be of any suitable type, though I prefer the type of burner which is illustrated and described in the copending application of Earl H. Howard, Serial No. 613,014, filed May 23, 1932, for Handle for electrical devices, in which is described a plug and receptacle connector the major portions of which are incorporated in Fig. 2 herein. The plug section 25, comprises a suitable plate 26 upon which is mounted a pair of extending electrical terminals 27 and 28 in the form of cylindrical prongs attached to the plate 26 each of which has an enlargement 29 thereon for the purpose of engaging beneath the top plate 30 of the receptacle section 31 to lock the same in engagement with the receptacle when the terminals are inserted through suitable keyhole shaped openings 32 in the plate 30, and partially rotated relative to the plate 30.

The receptacle section 31 is provided with a pair of metallic terminals 33 and 34 mounted upon the rear plate 35 of the receptacle section, the location of such terminals 33 and 34 being somewhat offset from direct alignment with the enlarged portion 36 of the opening 32 so that in order to make electrical connection between the terminal 33 and the plug terminal 27, it is necessary to insert the terminal 27 and then partially rotate the same relative to the receptacle. The plug section 25 is illustrated as having a suitable guide stem 37 extending from the center thereof to enter an opening 38 in the top plate 30 of the receptacle and to extend through a corresponding opening 39 in the rear plate 35 of the receptacle so as to center and guide the terminals 27 and 28 into the receptacle and also to constitute a pivot bearing for determining the axis of rotation of the plug section 25 as the same is partially rotated to engage the receptacle terminals 33 and 34.

As is described in the copending application of Ralph Hyde and Ellis O. Erickson, Serial No. 700,978, filed December 5, 1933 and issued as United States Letters Patent No. 2,002,776 on May 28, 1935, for Safety system for therapeutic lamps, the stem 37 may be provided with a reduced end 40 having one side thereof flattened as indicated at 41 to pass behind a movable contact 42 mounted upon the rear of the plate 35 so that when the plug section 25 is rotated relative to the receptacle, the end 40 will engage and move the movable contact 42 into engagement with a stationary contact 43 comprising a switch connected in series relation with the primary winding of the transformer 3. Such arrangement insures that the plug must first be inserted and then rotated in order to make an electrical contact between the receptacle terminals 33 and 34 and the plug terminals 27 and 28 and also by such partial rotation the enlargement 29 on the plug terminals 27 and 28 will engage the rear surface of the receptacle plate 30 to lock the same against inadvertent withdrawal therefrom. At the same time the insertion and rotation of the plug terminals 27 and 28 will close the switch 42—43 to close the circuit to the primary winding to the transformer or to prepare the same to be closed by the manual switch 5. Also such arrangement will insure that in order to remove the plug section 25 from the receptacle, or in order to disconnect the terminals 27—33, 28—34, a partial rotation of the plug in the reverse direction must be made which will first open the switch 42—43 to disconnect the primary winding of the transformer before the terminals 27—33, 28—34 will be disconnected.

With an arrangement such as that described in the Hyde and Erickson application referred to above, the transformer is automatically disconnected before any arcing condition could arise. However, when the receptacle section 31 is to be applied to the burners 10 or 19, it is difficult, if not impossible, to conduct the primary circuit of the transformer to the remote locations of these receptacles and in such instances it is the common practice to dispose with the switch 42 and 43 at these points. Also it may be undesirable to employ the switch 42—43 even upon the receptacles 8 or 9, and such receptacles may be adequately protected against arcing of the high potential current flowing through the terminals of the receptacle and plug connectors by providing a spark gap in each of the receptacles. Such spark gap may be constructed in a very simple manner, as illustrated herein, by providing a pair of strips of metal 44 and 45, one of which is connected to the receptacle terminal 33 while the other of which is connected to the receptacle terminal 34. The outer ends of the two metallic

strips 44 and 45 are mounted in close relation to each other and preferably have a portion thereof bent outwardly relative to the body of the strip as indicated at 46 and 47.

By locating the ends 46 and 47 close to each other, for example about ⅛th inch apart, any disconnection of the plug terminals 27 and 28 from the receptacle terminals 33 and 34 would cause an arc to be drawn in excess of ⅛th inch, and such high potential current will find a path of lesser distance and lesser resistance between the ends 46 and 47 of the metal strips 44 and 45. Hence instead of the arc passing between the receptacle terminals and the plug terminals the arc will be confined across the ends 46 and 47 of the metal strips, thus effectively peventing the arc from extending out of the receptacle to a position endangering the person handling the machine.

As is illustrated particularly in Fig. 4, the metal strips 44 and 45 may be formed of bimetallic material so that as soon as an arc is drawn between the ends 46 and 47 the heat generated by such arc will cause the bimetallic strips to expand and approach each other, as indicated in dotted lines in Fig. 4, until the ends 46 and 47 are accurately in metallic engagement with each other so that no further arcing is permitted. Any cooling of the strips which would tend to reform the arc will instantly cause sufficient heat to close the contact between the ends 46 and 47 and thus effectively prevent such arc from attaining any considerable proportions.

It will be understood by those skilled in the art that the type of transformer which is employed in connection with electrotherapeutic apparatus, has its windings so arranged that such transformer may stand indefinitely with its secondary winding short-circuited without causing any injury to the transformer so that the actual short-circuiting of the secondary winding of the transformer by the contacts 46 and 47 will not result in any damage, but will insure safety of operation for the persons handling the machine.

By employing the spark gap construction illustrated herein in each of the receptacle connections employed with high potential apparatus, any inadvertent disconnection of the connectors will be rendered harmless. Also the spark gap arranged in accordance with my invention will constitute a safety system for the protection of persons handling the machine and persons treated by the machine in the event of breakage of the burners or in the event of breakage of the conductors employed for conducting the high potential current, since as soon as any condition arises which would permit a high potential discharge at any point other than through the lamp of the burner, the arc will pass between the metallic strips 44 and 45 instead of through a path of higher resistance which latter path might endanger persons working with the machine. The employment of my safety device is, therefore, adaptable to such types of plugs and receptacles as shown in the copending application of Hyde and Erickson, hereinbefore referred to, as a safety measure in addition to the employment of the switch 42 and 43 in the circuit of the primary winding of the transformer.

In Fig. 7 I have illustrated a wiring diagram which may be employed in connection with my invention, such diagram illustrating the connections for the transformer 3 and the connections of the metallic strips 44 and 45 for each of the receptacles. The primary winding 4 of the transformer is illustrated as being connected to a suitable source of electric supply, indicated by the legend 110-*v.*, by connecting one terminal 50 of the winding 4 to the source of supply through conductor 51. The opposite end of the primary winding 4 is illustrated as being provided with a plurality of taps each of which is connected by way of conductors 52, 53 and 54 to suitable terminals 55, 56 and 57, respectively. The terminals 55, 56 and 57 may be engaged by a movable contact 58 of the switch 5 to connect any one of these terminals to a conductor 59 which extends to the movable contacts 42 of the switches 42—43, each of the receptacles 8 and 9. The stationary contacts 43 of these switches may be connected to a conductor 60 which extends to the opposite side of the low voltage supply.

The secondary or high potential winding 7 of the transformer is illustrated as having its opposite ends connected to the receptacle terminals 33 for each of the receptacles, while the terminals 34 of each of these receptacles may be connected through a suitable conductor 61 to the midpoint 62 of the secondary winding 7 and are also preferably grounded upon metallic parts of the machine, as indicated at 63.

The metallic contacts 44 and 45 may therefore be respectively connected in parallel relation with their respective receptacle terminals 33 and 34.

My spark gap may also be employed in connection with signs or other illuminating apparatus employing tubular lamps of the neon type by interposing such spark gap in shunt relation to selected sections of such lamps. For example, in Fig. 8 I have illustrated diagrammatically a form of wiring connection which can be employed for supplying current from a single transformer 70 to a plurality of tubes 71, 72, 73 and 74, making up a sign display. Each of the tubes 71, 72, 73 and 74 is respectively connected across a section 75, 76, 77 and 78 of the secondary winding 79 of the transformer 70. By interposing a spark gap 80 in shunt relation to each of the tubes 71, 72, 73 and 74, breakage of one of these tubes or disturbance of the circuit from one of these tubes will automatically result in cutting out that part of the circuit which supplies current to that tube, but will permit the continued operation of the remainder of the tubes.

While I have shown and described the preferred embodiment of my invention, I do not wish to be limited to any of the details of construction described herein, except as defined in the appended claim.

I claim:

In a safety device for electrical apparatus employing high potential electric current derived from a transformer having a high potential winding, a plug and receptacle connections for connecting said electrical apparatus with said high potential winding, said receptacle having a pair of terminals for the passage of high potential current therethrough, a spark gap comprising a pair of spaced bimetallic members, one connected to each of said terminals to limit an arc which may be drawn between said plug and receptacle connections for the distance defined by said spark gap whereby the heat of an arc drawn between said bimetallic members will reduce the distance therebetween.

RALPH C. HYDE.