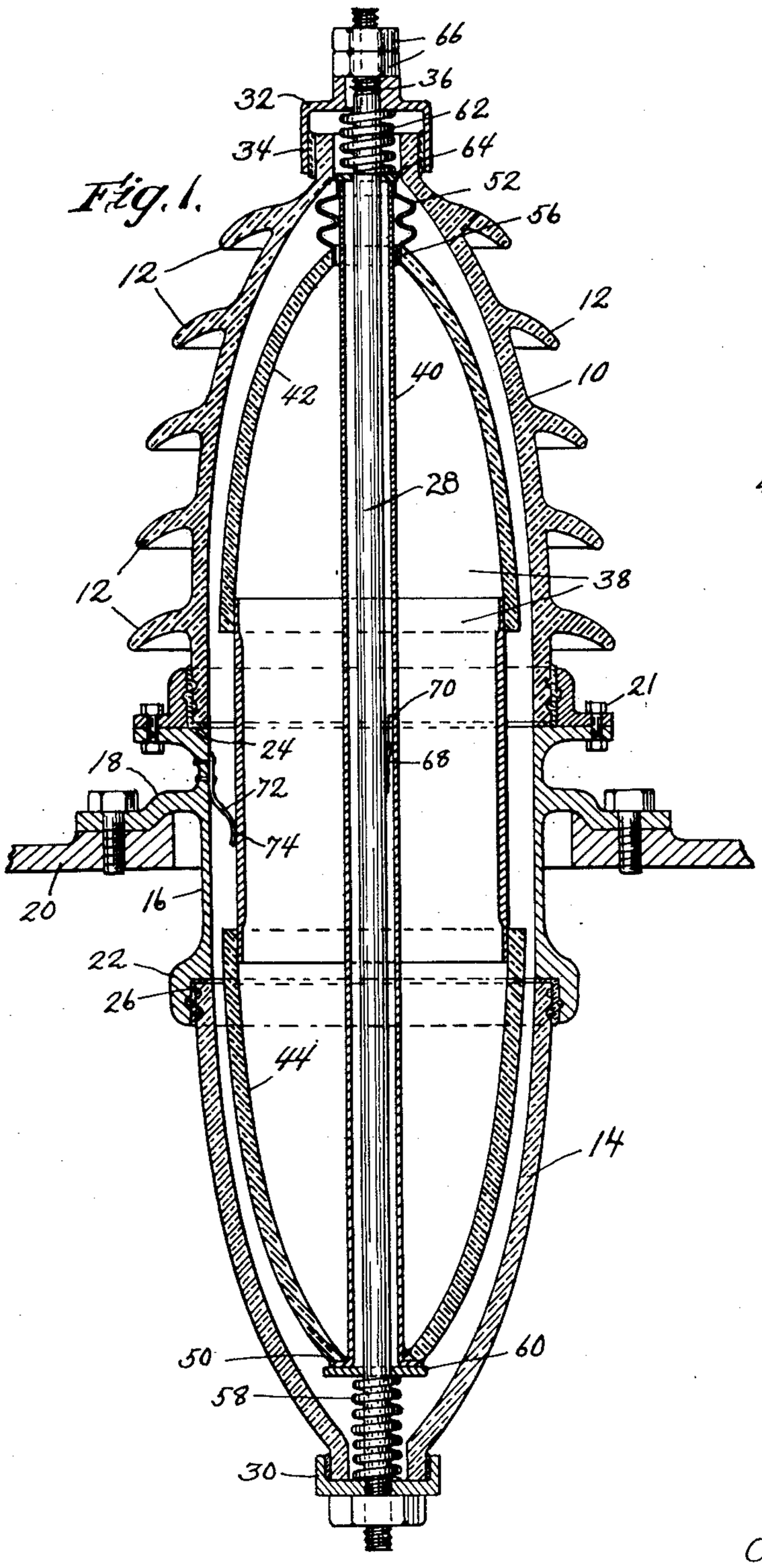
Feb. 14, 1933. G. E. JANSSON 1,897,257

VACUUM TYPE INSULATING BUSHING

Filed July 20, 1929

Fig. 1.



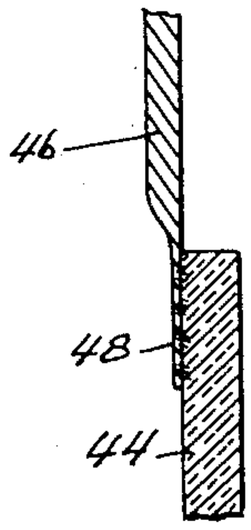


Fig. 2.

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UNITED STATES PATENT OFFICE

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VACUUM-TYPE INSULATING BUSHING

Application filed July 20, 1929. Serial No. 379,758.

This invention relates to insulating bushings which are used for the protection of high potential electric conductors where they pass through a grounded wall structure, as the enclosing casing of an electric apparatus; and has particular reference to bushings of this type which employ a highly evacuated envelope as an insulating means between the conductor and casing.

It is well known that if the vacuum within the exhausted envelope be sufficiently high it is impossible to pass a static discharge therethrough at any potential with which we are familiar. Evacuated envelopes have hitherto been composed wholly of frangible material, as glass, and if for any reason the vacuum becomes impaired after continuous use and a discharge takes place through the evacuated envelope, the envelope is destroyed, due to the rupture of the glass or its destruction due to the heat generated by the discharge. In order to overcome this disadvantage, it has been proposed to provide metal screens which are sealed within the envelope adjacent the stud and the supporting flange of the insulator. This necessitates, however, bringing out conductors through the inner and outer walls of the envelope, a construction which has many disadvantages.

It is an object of the present invention to provide a high tension insulating bushing having an evacuated envelope disposed between the stud and flange thereof which will not be destroyed by the occurrence of a discharge between the stud and flange.

A further object of the invention is to provide an evacuated envelope for an insulating bushing having its side walls composed of both insulating and conducting material.

A still further object of the invention is the provision of an insulating evacuated envelope having intermediate inner and outer metal side walls disposed in the vicinity of the supporting flange of the insulator and having provision for permitting an electric connection of said side walls with the adjacent stud and supporting flange.

A further object of the invention is the provision of a generally tubular evacuated envelope having an inner metal wall adjacent the stud and an outer wall composed largely of insulating material, and means to permit a different degree of expansion and contraction of said inner and outer walls.

A yet further object is generally to improve the construction and performance of bushing-type insulators.

Fig. 1 is a sectional elevation of an insulating bushing embodying the present invention.

Fig. 2 is a detail of a gas-tight welded joint between adjacent glass and metal sections of said envelope.

As herein shown, the insulating bushing embodying the invention has an outer insulating casing which includes an upper insulating shell 10 open at the top and bottom and provided with annular capes or petticoats 12, a lower insulating shell 14 open at the top and bottom, and an intermediate connecting and supporting shell or sleeve 16 having an annular outstanding flange 18 by which the bushing is adapted to be secured to a casing wall 20 of a switch or transformer, which wall usually is at ground potential. One of said insulating shells, as the upper shell 10, is detachably connected to the outstanding flange 24 of said supporting sleeve by the attaching bolts 21. Said intermediate shell or sleeve 16 is extended substantially below said casing wall 20 and is terminated in an integral flange 22. Said shell 16 is further provided with a lower annular recess 26 in which the upper end of said lower insulating shell 14 is connected. An axial conducting stud 28 is disposed within said outer casing and extends through and beyond the open top and bottom ends thereof. Said stud is provided with screw threaded end portions at its extended ends and a cap 30 is screw threaded thereon at its lower end and is cemented to the open end of and provides a closure for said lower shell 14. A similar cap 32 provides a closure for the upper open end of said upper insulating shell 10 and is secured to said shell by a body of cement 34. Said cap 32 and stud are free for relative axial movements whereby to permit independent axial movement of both due to expansion and contraction thereof.

A spline 36 is located in confronting axial slots in said cap 32 and stud 28 whereby to prevent rotation of the stud in the bushing while permitting the aforesaid axial movement between the stud and the bushing, the lower end only of the stud being held against axial movement by being screw-threaded into the bottom cap 30.

In accordance with this invention, an evacuated envelope 38 is provided between said stud 28 and the grounded shell or sleeve 16 of the bushing. Said envelope includes an inner metallic tube 40 having an imperforate side wall which closely surrounds said stud 28 and an outer wall concentric with and spaced from said inner wall 40 and conformed substantially with the outer supporting casing of the bushing. According to the present invention, the outer wall of said envelope comprises an upper insulating shell 42, a lower and similar inverted insulating shell 44 and an intermediate electrically conducting, or metal, shell 46 which is disposed within and adjacent the supporting sleeve 16 of said bushing and is substantially coextensive therewith. Both insulating shells 42 and 44 are composed of glass or other fusible material. Means is provided to connect said intermediate metal shell 46 in a vacuum-tight manner at its upper and lower ends to the adjacent ends of said insulating shells 42 and 44. One manner of welding together contiguous sections of metal and glass or other fusible insulating material is shown in detail in Fig. 2, wherein the intermediate metal shell 46 is provided with a thin or knife-edge section 48 at its end which overlies and is closely adjacent and is fused to the side wall of said insulating shell 44. Such a joint, wherein the metal is permanently welded in a vacuum-tight manner to glass, is well known in the art and need not further be described.

Said inner wall or tube 40 is provided at its lower end with a thin integral outstanding flange 50 which overlies the bottom open end of the insulating shell 44 and which is permanently welded thereto to provide a gas-tight closure at the bottom end of said shell.

Means is provided to form a yieldable gas-tight closure between the upper open end of shell 42 and said inner tube 40. Said means includes an expansible, as corrugated, diaphragm 52 which is secured at its upper end to tube 40 as by soldering or welding and is secured at its lower end at 56 by welding to the upper open end of the insulating shell 42 in the manner above set forth.

Said evacuated envelope 38 is adapted to be supported within the outer enclosing casing free from deleterious mechanical contact therewith. To this end, a helical spring 58 of suitable length is disposed about the stud 28 between the lower end of envelope 38 and cap 30. A washer 60 is provided between said spring and the envelope. A similar spring and washer 62 and 64 respectively are provided at the upper end of said envelope, if desired. Suitable terminal clamping nuts 66 may be provided at the upper end of said stud 28 externally of said enclosing casing.

A resilient conducting strip 68 may be secured to stud 28 prior to placing it in the insulator which strip has a flexed contact portion 70 adapted to bear firmly against the inner wall of the metal tube 40 whereby to provide an electrical connection between said stud and tube. A similar resilient conducting strip 72 is carried by the intermediate metal shell 16 and has a contact portion 74 which bears against the outer wall of the metal shell 46 of the evacuated envelope 38 whereby to provide good electrical connection between said shell and the grounded casing 20 of the apparatus.

The envelope is evacuated to such a high degree that the space therein between the metal tube 40 and shell 46 is non-conducting and cannot be broken down by any commercial potential now used for transmission purposes. It will be evident that if, for any reason, while in service, the insulating properties of the envelope 38 are impaired, and a static discharge takes place through the evacuated dielectric thereof, such discharge must of necessity take place between the confronting faces of the tube 40 and shell 46, and the frangible shells 42 and 44 of the envelope will not be subjected to the destructive action of the discharge. Thus, the bushing, instead of being irreparably destroyed, as must of necessity be the case with prior insulators of this type, can again be put in service by re-evacuating the envelope, since the structure thereof and particularly the insulating walls thereof will remain intact.

The construction may be modified in various ways without departing from the scope of the invention.

I claim:

1. In an insulating bushing, the combination of an outer insulating and supporting shell, an axial conducting stud extended through said shell, and means disposed between said stud and shell including a composite evacuated envelope having serially connected wall-sections of insulating and conducting material.

2. In an insulating bushing, the combination of an outer insulating and supporting shell, an axial conducting stud extended through said shell, and a highly evacuated envelope disposed between said stud and shell, said envelope including a pair of spaced insulating shells and an intermediate shell of conducting material connecting said insulating shells in a vacuum tight manner.

3. In an insulating bushing, the combination of an outer shell including upper and

lower insulating members and an intermediate conducting member, an axial conducting stud extended through said outer shell, and means including a highly evacuated envelope interposed between said shell and stud, said envelope characterized by having its outer wall composed of upper and lower insulating sections and an intermediate conducting section, said conducting section being opposed to and electrically connected with said intermediate conducting member of said outer shell.

4. In an insulating bushing, the combination of an outer insulating and supporting shell including upper and lower insulating sections and an intermediate conducting section, an axial conducting stud extended through said shell, and means disposed between said shell and said stud including a highly evacuated envelope, said envelope comprising a metal tube closely surrounding said stud and electrically connected therewith and a concentric outer tube including upper and lower insulating shells having a gas-tight connection at their upper and lower ends respectively with said inner tube and an intermediate conducting portion having a gas-tight connection with the confronting ends of said insulating sections, said intermediate section having an electrical connection with the intermediate section of said outer casing.

5. In an insulating bushing having concentric spaced conducting members, an evacuated envelope disposed between said members including two concentric tubes having gas-tight connections at their upper and lower ends, the inner and outer walls of said envelope in the vicinity of said spaced conducting mem bers comprising metallic sections which are electrically connected respectively with said inner and outer conducting members, said envelope having upper and lower insulating sections interposed between said metallic sections.

6. In a bushing structure, the combination of an outer insulating shell having a grounded supporting flange intermediate its ends, a conducting stud axially disposed therein and extended beyond the ends of said outer shell, and an evacuated envelope including inner and outer concentric tubes surrounding said stud, said envelope characterized by having the tubes which constitute its side walls composed of contiguous sections of metallic and vitreous material welded together in a gas-tight manner.

7. In a bushing structure, the combination of an outer insulating shell having a grounded supporting flange intermediate its ends, a conducting stud axially disposed therein and extended beyond the ends of said outer shell, and an evacuated envelope including inner and outer concentric tubes surrounding said evacuated envelope located between said stud the tubes which constitute its side walls composed of contiguous sections of metallic and vitreous material welded together in a gas-tight manner and having said sections so disposed that the metal sections of its inner and outer walls are located in proximity to said supporting flange and stud.

8. In a bushing structure, the combination of an outer insulating shell including an intermediate metallic portion which constitutes a support for the bushing, an axial stud extended through said bushing, and an evacuated envelope disposed within said outer shell and surrounding said stud, said envelope including an inner metal side wall adjacent said stud and an outer concentric side wall composed of upper and lower insulating sections which are welded in a vacuum tight manner to said inner tube at the top and bottom thereof, and an intermediate conducting section substantially conterminous with the intermediate metallic portion of said outer shell having its upper and lower ends welded to the confronting ends of said upper and lower insulating sections.

9. An insulating bushing including an axial conducting stud, an enclosing casing including a conducting sleeve concentric with and spaced from said stud intermediate its ends, and insulating means disposed between said stud and casing and extended above and below said sleeve including an evacuated envelope having an inner metallic tube, and an outer composite tube composed of upper and lower insulating sections having their remote ends welded to the ends of said metal tube, and an intermediate conducting section having its ends welded to the adjacent ends of said insulating sections and disposed in confronting relation with said sleeve.

10. An insulating bushing including an axial conducting stud, an enclosing casing including a conducting sleeve concentric with and spaced from said stud intermediate its ends, and insulating means disposed between said stud and casing and extended above and below said sleeve including an evacuated envelope having an inner metallic tube, and an outer composite tube composed of upper and lower insulating sections having their remote ends welded to the ends of said metal tube, and an intermediate conducting section having its ends welded to the adjacent ends of said insulating sections and disposed in confronting relation with said sleeve, and means electrically connecting said inner metallic tube with said stud and said intermediate conducting section of said envelope with said sleeve.

11. A high potential insulating bushing comprising an axial conducting stud, a supporting structure including a conducting sleeve which is concentric with and is spaced from said stud intermediate its ends, and an stud, said envelope characterized by having

and sleeve comprising an inner metallic tube, an outer composite tube concentric with and spaced apart from said inner tube, said outer tube comprising an intermediate section of conducting material which is adapted to occupy that region of the electrostatic field of greatest intensity, and insulating end-sections having their confronting ends welded to the adjacent ends of said intermediate section and having their free ends conterminous with and welded to the ends of said inner tube.

12. An evacuated envelope for a high potential insulating bushing comprising a straight and rigid inner metallic tube, a rigid outer composite tube concentric with and spaced apart from said inner tube, said outer tube comprising an intermediate section of conducting material which is adapted to occupy that region of the electrostatic field of greatest intensity, and insulating end-sections having their confronting ends welded to the adjacent ends of said intermediate section and having their free ends connected to the ends of said inner tube, and means to permit a different degree of axial expansion of the inner and outer tubes of said envelope.

13. An evacuated envelope for a high potential insulating bushing comprising a rigid inner metallic tube, a rigid outer composite tube concentric with and spaced apart from said inner tube, said outer tube comprising an intermediate section of conducting material which is adapted to occupy that region of the electrostatic field of greatest intensity, and insulating end-sections having their confronting ends welded to the adjacent ends of said intermediate section and having their free ends connected to the ends of said inner tube, and means including an expansible diaphragm interposed between adjacent sections of said envelope to permit a different degree of axial expansion thereof.

14. In an insulating bushing, the combination of a metal collar, a conducting stud extended through and spaced apart from said collar, a highly evacuated composite envelope composed of insulating and conducting material surrounding said stud and occupying the space between said collar and stud, said envelope having its inner and outer side walls in the vicinity of said collar composed of non-frangible conducting material.

15. A vacuum type insulating bushing including, in combination with a conducting stud, a highly-evacuated envelope consisting of an inner metal tube which constitutes an inner vacuum-sustaining wall of said envelope surrounding said stud, an outer metal tube which surrounds and is spaced from said first tube and constitutes an outer vacuum-sustaining wall of said envelope, walls of insulating material sealed to and connecting said tubes, and means supporting said envelope including a supporting sleeve surrounding said outer metal tube.

16. A vacuum type insulating bushing including, in combination with a conducting stud, a highly-evacuated envelope consisting of an inner metal tube which constitutes an inner vacuum-sustaining wall of said envelope surrounding said stud, an outer metal tube which surrounds and is spaced from said first tube and constitutes an outer vacuum-sustaining wall of said envelope, walls of insulating material sealed to and connecting said tubes, and means supporting said envelope including a supporting sleeve surrounding said outer metal tube, and means electrically connecting said tubes with said stud and supporting sleeve respectively.

17. A vacuum-type insulating bushing including an outer enclosing casing having an intermediate metal sleeve and upper and lower insulating shells attached to the opposite ends of said sleeve, a highly evacuated envelope located within said enclosing casing including an intermediate metal tube located within and confronting said metal sleeve of said enclosing casing, and upper and lower insulating shells attached in a vacuum-tight manner to the opposite ends of said tube and located within and confronting the upper and lower insulating shells respectively of said enclosing casing, a metal tube extended through said envelope and constituting the inner wall thereof and having vacuum-tight connections with the upper and lower ends of said insulating shells thereof, and a conducting stud extended through said last metal tube and through the ends of said enclosing casing and having a support therein.

18. A vacuum-type insulating bushing including a conducting stud, a highly-evacuated insulating envelope for said stud and consisting of a straight and rigid metal tube through which said stud extends, an insulating wall surrounding said tube, and vacuum-tight connections between said tube and said wall including means to permit the independent free axial expansion and contraction of both.

19. A vacuum-type insulating bushing including an enclosing casing, a conducting stud extended therein, a highly-evacuated insulating shell surrounding said stud within said casing and resilient means to support said insulating shell free from deleterious mechanical contact with said enclosing casing, said resilient means comprising a spring surrounding said stud and interposed between said insulating shell and casing.

20. A vacuum-type insulating bushing including an enclosing casing, a conducting stud extended therein, a highly-evacuated insulating shell surrounding said stud within said casing, and resilient means to support said insulating shell free from deleterious mechanical contact with said enclosing cas-

ing, said resilient means comprising springs surrounding said stud at the opposite ends thereof and interposed between the casing and the adjacent ends of said insulating shell.

In testimony whereof, I have signed my name to this specification.

GUSTAV E. JANSSON.

CERTIFICATE OF CORRECTION.

Patent No. 1,897,257. February 14, 1933.

GUSTAV E. JANSSON.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, line 74, for "flexed" read "reflexed"; page 3, line 65, claim 7, strike out the words "evacuated envelope located between said stud" and insert instead "stud, said envelope characterized by having"; and same page, line 130, claim 11, for "stud, said envelope characterized by having" read "evacuated envelope located between said stud"; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 11th day of April, A. D. 1933.

M. J. Moore.
Acting Commissioner of Patents.

(Seal)