Oct. 24, 1950 E. H. TAYLOR 2,527,160

PLUG TYPE FUSE

Filed Sept. 12, 1947

Fig. 1

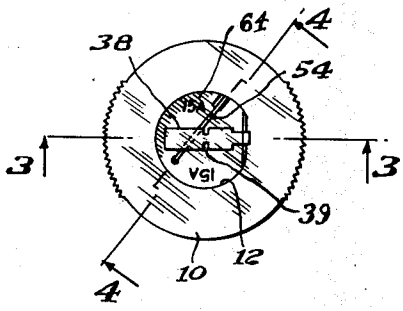


Fig. 3

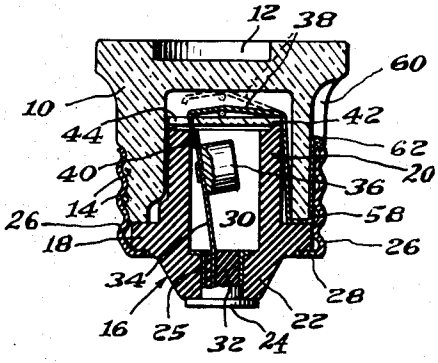


Fig. 2

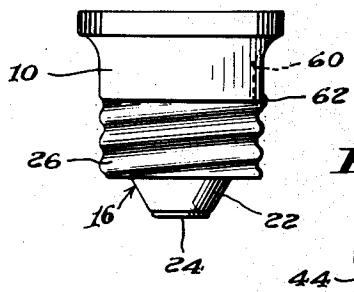


Fig. 4

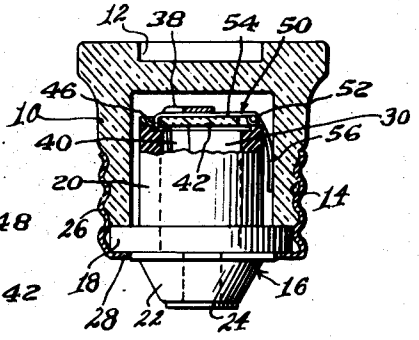
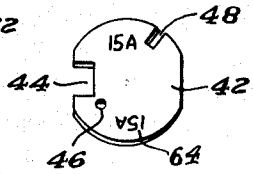


Fig. 5



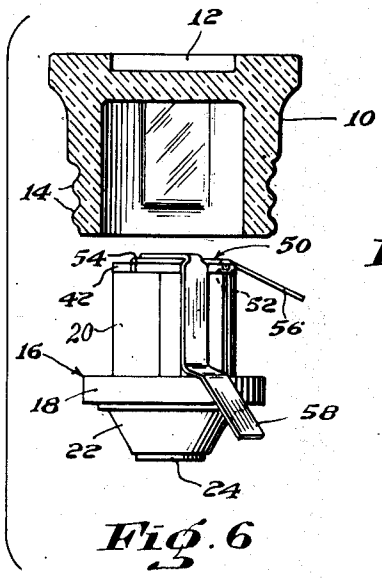
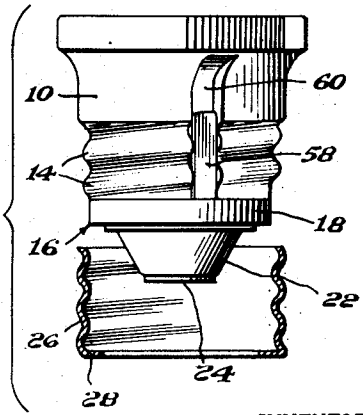


Fig. 6

Fig. 7



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2,527,160

PLUG TYPE FUSE

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Application September 12, 1947, Serial No. 773,611

13 Claims. (Cl. 200—130)

1

This invention relates to improvements in protective devices for electrical circuits and methods of producing them. More especially it relates to fusible protective devices of the plug-fuse general type, and particularly to such fuses having provision therein for opening a circuit substantially instantaneously on heavy overloads of the order of a short-circuit, and for opening a circuit with predetermined time delay in response to moderate overloads which persist beyond a predetermined period of time.

Fuses of the general type to which the invention relates ordinarily have an insulating body within which is operatively mounted a protective device including a fusible element, usually a fuse link, which is adapted to fuse in response to heavy overloads of short-circuit intensity, and a fusible connection, ordinarily effected by low melting temperature solder, with resilient means adapted to break the connection when the low melting temperature solder melts in response to a persistent moderate overload of predetermined character.

Heretofore, such fuses, of the plug type, have had their main bodies of porcelain for withstanding the relatively high temperatures and pressures generated within the plugs in reponse to fusing of a fuse link therein, and they have been equipped with a top-end window of mica, or the like, through which the condition of a fuse could be observed. The porcelain bodies have been difficult and expensive to produce, and the provision of an adequate resilient force for opening the protective device on persistent moderate overloads has involved difficult and expensive assembling procedures. A spring has been the conventional means for opening the protector at the low melting temperature solder connection, and it has required extreme care and patience to properly tension or load the spring during assembly of a fuse.

It has been customary in such fuse plugs to employ a fuse link of copper or copper alloy having relatively high electrical conductivity, and to connect one end of the fuse link by low melting temperature solder to a resistance heating element adapted to heat and ultimately to melt the solder on moderate overloads of predetermined character and duration. When the solder melts, a spring separates the fuse link from the heater element to open the circuit.

Use of a high conductivity fuse link, of copper or the like, has the advantage that it generates relatively little heat under normal operating conditions and does not generate objectionable heat under moderate overload conditions. Consequently, it introduces relatively small watt losses as compared with a zinc fuse link, for example. But copper must be elevated in temperature to 1980° F. before it will fuse, which means that a temperature of 1980° F. prevails within a fuse plug when a copper link fuses in response to a severe overload. Such extreme temperatures will feature ordinary glass fuse bodies, and generated internal pressures may blow an ordinary glass fuse body to bits upon fusing of a copper link. Heretofore, only porcelain plug bodies have been acceptable for safely housing a copper fuse link or the like in such a fuse plug, and use of glass fuse plug bodies has had to be restricted, practically, to fuse plugs employing fuse links of zinc or other comparable materials having relatively low melting temperatures.

2

It is among the objects of the present invention to provide a fuse of the plug type wherein a fuse link, of copper or other comparable high melting temperature material, may be effectively enclosed within a plug body of glass without danger of fracture of the glass under the high temperature conditions incident to a fusing of the high melting temperature fuse link. The invention employs a plug body made of a glass which can withstand high temperatures without fracture, and provides means within the plug body for de-ionizing and cooling the high temperature products of a fusing of the fuse link.

Another object is to provide a plug fuse having conducting means, and a resilient means constantly tensioning the conducting means and itself adapted to be tensioned as a result of axial thrust of body elements of the plug relatively toward each other during assembly of a plug fuse. The conducting means and the resilient means are assembled and inter-engaged while the resilient means is free of tension, and the resilient means becomes tensioned, with resulting tensioning of the conducting means, in response to mere axial thrust of one body section relative to another body section.

A further object is to provide a plug fuse wherein a spring has one portion overlaid by a flexible conductor which normally holds said spring portion against appreciable movement, and wherein said conductor is secured in its said overlaid condition, and another portion of said spring is flexed and held, by walls of body sections, when the latter are thrust axially together during assembly of the plug fuse.

Yet another object is to provide a plug fuse having a recessed body section of glass and an

insulating base section having a recessed projection for entering the recess of the glass section when said sections are thrust relatively toward each other, and having a high melting temperature fuse link extending out of the recessed projection and laid over an edge of the projection and secured by walls of said sections when the sections are thrust together, there being a spring adapted to be engaged with said laid over portion of the fuse link while the spring is free of tension and to be tensioned in response to said axial thrust of the body and base sections relatively toward each other.

A still further object of the invention is to provide a sectional plug fuse body wherein a fuse link is adapted to fuse in response to overloads of one predetermined character and has a relatively low melting temperature solder connection at one end which is adapted to open in response to overloads of another predetermined character, there being a spring and carrier plate unit over which the fuse link is engaged, with the spring constantly tensioning the fuse link and itself tensioned in response to assembly of the body sections.

Still another object is to provide a method of assembling the elements of a plug fuse wherein a conducting means and a spring are associated together while both are substantially free of tension, and both become tensioned in response to a step of merely thrusting sections of the plug body into assembled relation.

It is, moreover, my purpose and object generally to improve the structure, operation and efficiency of plug type fuses.

In the accompanying drawing:

Fig. 1 is a top plan view of a fuse plug embodying features of the invention;

Fig. 2 is a side elevation of the fuse plug of Fig. 1;

Fig. 3 is a cross-sectional view on line 3—3 of Fig. 1, on a larger scale;

Fig. 4 is a cross-sectional view on line 4—4 of Fig. 1, on the scale of Fig. 3, with the lower portions of the base section of the plug body in elevation;

Fig. 5 is a perspective of the spring-supporting disk of paper, or the like;

Fig. 6 shows the two insulating sections of the plug body in separated relation, the main body section of glass being in medial cross-section, and the base section being in elevation, with the paper disk, spring, and fuse link in assembled relation thereon, and with the spring in untensioned condition ready to be tensioned or loaded by mere thrust of the two sections together; and

Fig. 7 shows, in elevation, the two insulating sections of the plug body thrust together, with the metal screw shell in separate relation and in medial cross-section, ready to be screwed on the glass body section.

Referring to the drawing, the plug fuse illustrated has a main body section 10 of heat resistant glass which, preferably, is of "Pyrex" glass, which can withstand high temperatures without fracture. Section 10 has the generally inverted cup shape as shown, with its top wall recessed as at 12 to facilitate observation of interior elements of the fuse through the thinned top wall, and with the threads 14 formed exteriorly of the side walls of the inverted cup-shaped section 10. A base section 16 may be of "Bakelite" or other comparable insulating material, and comprises the annular flange 18, for engaging the lower edge of the side walls of section 10, with the projection 20 loosely fitting within the hollow of section 10, and with the projection 22 depending axially at the base of the fuse plug and mounting the base contact 24. A metallic screw shell 26 threadedly engages the threads 14 of section 10 and has the annular flange portion 28 for engaging the margin of flange 18 of base section 16 thereby to clamp the sections 10, 16 together when the screw shell 26 is screwed tight on section 10.

The projection 20 of base section 16 is recessed to provide the relatively deep well 30 therein of which the projection 22 constitutes the bottom wall. Base contact 24 has a tubular shank 25 extending through the projection 22 and swaged interiorly of well 30 to secure the contact in place, with the contact providing a shallow cup open interiorly of the well 30 for reception of a quantity of relatively high melting temperature solder 32, or the like.

A conducting member 34 has its lower end permanently anchored in the solder 32 and may have a mass 36 of heat-absorbing material secured thereon adjacent to its upper end within the well 30. Another conducting member 38 has one end connected to the upper end of member 34 by relatively low melting temperature solder 40, and it is a feature of the invention that a plate 42 of insulating material, which may be paper, is arranged in closing relation to the mouth of well 30, with a notch 44 therein through which the conducting member 38 extends out of well 30 from its solder connection at 40.

According to the invention, the plate 42 has therein the small hole 46 and the narrow edge notch 48, and a spring 50 has its coil 52 engaged in edge notch 48 with one arm 54 extending across the plate 42 and engaged in hole 46, and with its other arm 56 resiliently depressed between the walls of body sections 10, 16 and held in depressed condition by the side wall of section 10, as best seen in Fig. 4. Conducting member 38 is flexible and is drawn tightly over spring arm 54 normally to maintain spring arm 54 against springing away from plate 42 when arm 56 is depressed, and member 38 extends across the plate 42 and down between the walls of body sections 10, 16, passing thence outward between the lower edge of section 10 and flange 18 of section 16, and being turned upwardly as at 58 (Figs. 3 and 7) into the exterior groove 60 in glass section 10. The screw shell 26 maintains the upwardly extending part 58 in the groove 60, and a small mass or gob of relatively high melting temperature solder 62 (Figs. 2 and 3) permanently electrically connects the upturned part 58 of conducting member 36 to the screw shell which latter constitutes one terminal of the fuse plug, as is usual.

The conducting member 34 may be of material and design to supply the heat for melting the solder 40 on the moderate overloads, in which case it may be made of a suitable copper alloy in rod or strip form preferably having sufficient stiffness to support the heat-absorbing mass 36, which latter may be of brass, for example. The conducting member 38 then may be a flexible fuse link of copper, or silver, or other comparable material of relatively high electrical conductivity, having a fusing notch at 39 (Fig. 1) at which the link is adapted to fuse on heavy overloads of the order of a short-circuit.

On the other hand, if desired, the conducting member 38 may be of material and design to serve both as a fuse link and a heater, in which case

the member 38 will supply the heat for melting the solder 40 on moderate overloads, and the conducting member 34 then may be of material and design to generate less heat than the member 38 and to be thermally resistant to heat transfer through it to the base contact 24. Also the member 38 may be designed to itself provide a considerable time delay before the solder 40 will melt on moderate overloads, thus eliminating the need for any heat-absorbing mass 36 in fuse plugs of relatively low ratings.

In any event, however, the invention provides important improvements in plug type fuses for protecting a circuit against moderate overloads of predetermined character as well as for protecting the circuit against heavy overloads comparable to a short-circuit. The invention makes it practicable to employ glass for the main body section 10 of the plug, with the economies incident to the manufacture of a glass section 10 as compared with the prior more expensive porcelain plug body sections which, heretofore, have been requisite for withstanding the relatively high temperatures developed in fuse plugs having provision for time delayed opening on moderate overloads. According to the invention, the plate 42 supports both the spring 50 and the laid-over portion of the fuse link 38 directly below the thinned top wall of the glass body 10, where they are readily visible through said thinned top wall. Also the plate is readily visible so that it conveniently may carry the amperage rating of the fuse plug, as at 64 in Figs. 1 and 5. Furthermore, the plate 42 provides substantially de-ionizing and cooling surfaces which tend materially to reduce the destructive effect of high temperature products of a fusing.

In assembling my improved fuse plug, the individual elements may be formed as may be convenient and practicable, and will be made available in suitable quantity at the assembly line. If a composite conducting means 34, 38 is to be used, as herein illustrated, the heater element 34, flexible conductor 38, and heat-absorbing member 36 may be preliminarily assembled, with the low melting temperature solder connection at 40. This composite unit will be supplied in generally straight form to the assembly line. At the first station of the assembly line, one of the pre-assembled conducting units 34, 38 is inserted through the well 30 of insulating base section to engage the free end of the heater element 34 in the recess of the center contact 24, after which a suitable quantity of high melting temperature solder 32 is deposited in said recess. The insulating base section, with the conducting unit thus mounted therein then may pass to a second station at which an untensioned spring 50 is mounted on a plate 42 with the end of spring arm 54 engaged in hole 46 of the plate and with the coil 52 of the spring in the edge notch 48 of the plate, after which the plate-spring unit is arranged on the end of projection 20 of the base section, over the mouth of well 30, with the flexible conductor 38 extending in the notch 44 of plate 42. The flexible conductor 38 next is laid over the spring arm 54 and plate 42 and bent downward over the side of projection 20, as illustrated in Fig. 6, the spring meanwhile continuing free of tension. A glass body section 10 is then thrust relatively over the assembled elements on projection 20, thereby to depress spring arm 56 toward projection 20 while the laid over portion of the flexible conductor holds spring arm 54 by being engaged

between the walls of projection 20 and glass section 10. Then the projecting portion 58 of the flexible conductor 38 is turned upward into groove 60, as shown in Fig. 7, shell contact 26 is screwed on glass section 10, and a gob of high melting temperature solder 62 is deposited to connect conducting part 58 to the shell, and the fuse plug is ready for packaging. If the initial solder connection of element 34 at 32 happens to be defective, the element 34 will pull away when the flexible conductor 38 is laid over the spring arm 54. Hence when a fuse plug reaches the final assembly station without any breaking of a solder connection, there is assurance that the fuse plug must be perfect without need for any final inspection, assuming that the composite parts were perfect and proper.

It will be apparent that the spring 50 becomes easily, quickly and automatically loaded merely as a result of thrust of the plug body sections together, which avoids the heretofore troublesome and tedious procedure of tensioning a spring and holding it tensioned while securing it in its tensioned condition.

I claim as my invention:

1. In a fuse plug, body sections adapted to be associated together by axial thrust of the sections relatively toward each other, one of said sections having a recess therein and another of said sections having a projection adapted to enter said recess, said projection having a relatively deep well therein open into the said recess, conducting means anchored at one end within the well of said projection and having a flexible portion disposed across the mouth of said well so as to extend within said recess when the body sections are associated together, a resilient element having a portion extending generally cross-wise of and engaged under said flexible portion of said conducting means and having another portion depressed and tensioned between inter-fitting portions of said sections at a location substantially spaced from the regions of extent of said conducting means.

2. In a fuse plug, body sections adapted to be associated together by axial thrust of the sections relatively toward each other, one of said sections having a recess therein and another of said sections having a projection adapted to enter said recess, said projection having a relatively deep well therein open into the said recess, conducting means anchored at one end within the well of said projection and having a flexible portion extending across the mouth of said well and thence between inter-fitting portions of said sections, a resilient element having a portion extending generally cross-wise of and engaged under said flexible portion of the conducting means which is disposed across the mouth of the well, and having another portion depressed and tensioned between inter-fitting portions of said sections at a location substantially spaced around the axis of the fuse plug from the location of the portion of the conducting means which extends between inter-fitting portions of the said sections.

3. In a fuse plug, a body section having a projection with walls defining a relatively deep well, a contact on said section at the bottom of said well, conducting means electrically connected to said contact and having extent in said well, said conducting means having a flexible portion extending out of the well, a member mounted on the projected end of said projection and extending across the mouth of said well, said flexible portion of the conducting means being drawn

across said member and turned over the edge of said projection whence it extends along the projection, said member being held on the end of the projection by said flexible portion of the conducting means, a resilient element mounted on said member having one portion extending generally cross-wise of and engaging under said flexible portion of the conducting means, and having another portion depressed and tensioned beside the said projection in spaced relation to said turned-over extent of the flexible portion of the conducting means, and a second body section adapted to be associated with the first mentioned body section by axial thrust of the sections relatively toward each other and maintaining said depressed portion of the resilient element in its depressed tensioned condition and maintaining said turned-over extent of the flexible portion of the conducting means against longitudinal movement.

4. In a plug fuse having body and base sections fitted together to provide an interior enclosed chamber and having a flexible conductor extending within said chamber, means for tensioning said conductor within the chamber comprising a projection on said base section having substantial extent within said chamber, a spring having generally oppositely disposed arms adapted to be mounted at the inner end of said projection with one arm extending across the inner end of the projection and the other arm depressed and tensioned between the projection and an adjacent wall of the said body section, said flexible conductor having one end anchored to the base section and being drawn across the inner end of said projection and across and over the spring arm at the inner end of the projection, extending thence over the edge of the projection and along the projection between the projection and an adjacent wall of said body section and at a location around the axis of the plug substantially spaced from said depressed arm of the spring.

5. A fusible protective device comprising an insulating base member having a projection thereon with a relatively deep well therein open at the free end of the projection, a center contact mounted in the bottom wall of the well and exposed exteriorly of the base member, a plate member of insulating material arranged on the free end of said projection across the mouth of said well, a generally hollow glass body secured to said in sulating base member with said plate member in the hollow of the body, a second contact exteriorly of the glass body, a pair of electrical conductors of which at least one is a fusible conductor adapted to fuse when subjected to a current of predetermined magnitude, fusible material holding one end portion of one of said conductors in electrical connection with one end portion of the other of said conductors and adapted to lose its holding power when heated to a predetermined temperature, the other ends of said conductors being connected respectively to said center contact and said second contact, and one of said conductors having a portion extending across said plate member and holding the plate member on the end of said projection, a spring having a first arm extending generally cross-wise of and under said portion of a conductor which extends across said plate and having a second arm depressed and held between walls of said insulating base member and said glass body thereby to tension the said first arm of the spring and the conductor engaged thereby.

6. A fusible protective device comprising a body having inter-fitting body members providing an enclosed space within the body, a pair of terminals on the body insulated from each other, current conducting means electrically connecting said terminals and having a portion extending within said enclosed space within the body, and means for tensioning at least a portion of said conducting means comprising a resilient member having one part extending cross-wise of and under said portion of the conducting means which extends within said enclosed space, and having another part which is flexed and held between walls of said inter-fitting body members at a location spaced from the conducting means in direction around the axis of the device.

7. A protective device for electric circuits, comprising a composite body having an enclosed space therein, and having inter-fitting body sections, a pair of terminals insulated from each other on said body, current conducting means electrically connecting said terminals and having a flexible portion extending within said enclosed space, a resilient member having an end part engaged by said flexible portion of the conducting means, said composite body having sections thereof associated together by thrust of the sections relatively toward each other, and said resilient member and said flexible portion of the conducting means each having parts separately engaged and held between said sections at different angular locations around the axis of the device, whereby said flexible portion of the conducting means restrains said engaged end part of the resilient member and said resilient member is flexed to maintain said flexible portion of the conducting means under tension.

8. In a fuse plug having insulating body sections associated together by axial thrust of the sections relatively toward each other, one of said sections having a recess therein and the other having a part projected into said recess, a resilient element, a plate carrying said resilient element and itself arranged on the inner end of said projected part in said recess, conducting means anchored to the body section which has said projecting part and having a flexible portion laid over the resilient means on said plate and extending thence over the edge of the plate and along the said projecting part of one section, said resilient means having a portion depressed between said projecting part of one section and an adjacent wall of the other section at a location substantially spaced from the conducting means, whereby the conducting means is tensioned at its said laid-over portion.

9. In a fuse plug having body sections fitted together by axial thrust to define an interior enclosed space, and having a flexible conductor extending within said space, means for tensioning said conductor comprising a resilient element and a carrier plate having means thereon for holding said resilient element with one portion thereof extending over a face of the plate and with another portion depressed over the edge of the plate, said flexible conductor being drawn over and across said one portion of the resilient element on the face of the plate binding said portion to the plate, and said depressed portion of the resilient element imparting tension to said bound portion of the resilient element and to the drawn-over flexible conductor.

10. In a plug fuse having male and female body sections associated together by axial thrust, a resilient element arranged on the inner end of

the male section, a flexible conductor drawn over and across the resilient element on the inner end of the male section and holding a portion of the resilient element against movement away from the inner end of the male section, said resilient element having another portion depressed and held between walls of the male and female body sections at a location substantially spaced from the flexible conductor, whereby both the resilient element and the flexible conductor are tensioned at the inner end of the male body section.

11. A fuse plug comprising a recessed body section of insulation material, a base section of insulation material having a projection projected into the recess of the body section and having a relatively deep well therein open into the recess of the body section, conducting means anchored in the well of said projection and having a flexible portion extending out of the well, an insulating plate arranged on the inner end of said projection across the mouth of said well, said flexible portion of the conducting means being laid over said plate and over a side of the projection, resilient means mounted on said plate having a portion extending across and under said laid over portion of the conducting means and having another portion depressed and tensioned between walls of the body sections at a location spaced around the axis of the plug from said conducting means.

12. In the art of plug fuse manufacture, the method of tensioning a fusible element within the plug in response to axial thrust of body sections of the plug, comprising arranging a spring while free of tension on a supporting part of one body section with one arm of the spring extending across the supporting part and with another arm of the spring projecting beyond the edge of the supporting part, followed by drawing a flexible fusible element across the supported arm of the spring so as to bind the spring to the support, and then, while holding the fusible element in its said binding relation, thrusting the said

supporting part of one body section in a recess in another body section thereby to depress said projecting arm of the spring between walls of the two body sections at one location around the axis of the plug and to engage and secure said flexible fusible element between walls of said sections at another location around the axis of the plug.

13. In the art of plug fuse manufacture, the method of tensioning a fusible element within the plug in response to axial thrust of body sections of the plug, comprising mounting a spring on an insulating plate with the spring free of tension and with one arm of the spring extending across a face of the plate and with another arm projecting beyond the edge of the plate, arranging the plate on a supporting part of one body section of the plug with the said projecting arm of the spring projecting beyond the said supporting part of the section, wrapping a flexible fusible element over the said plate and across the spring arm thereon thereby to bind the spring arm to the plate and the plate to said supporting part, and then thrusting said supporting part of one body section into a recess in another body section thereby to depress said projecting arm of the spring between walls of the two sections at a location around the axis of the plug spaced from the fusible element.

ELMER H. TAYLOR.

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Certificate of Correction

Patent No. 2,527,160 October 24, 1950

ELMER H. TAYLOR

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 2, line 9, for the word "feature" read *fracture*; column 5, line 34, for "substantially" read *substantial*;

and that the said Letters Patent should be read as corrected above, so that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 2nd day of January, A. D. 1951.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.

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