

Nov. 14, 1939.

P. J. KAYATT

2,179,935

HIGH POTENTIAL CUT-OUT

Filed May 28, 1937

Fig. 1.

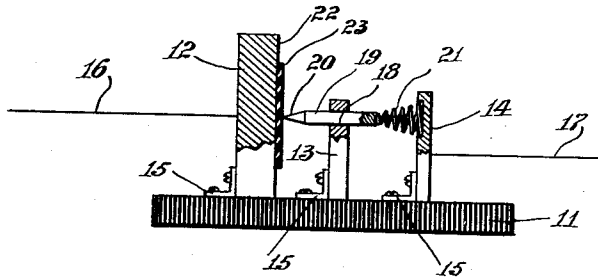


Fig. 2.

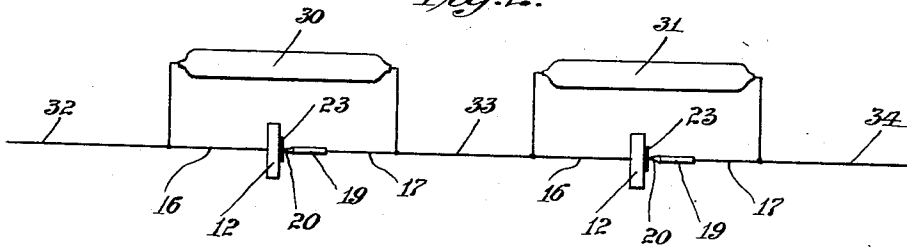


Fig. 3.

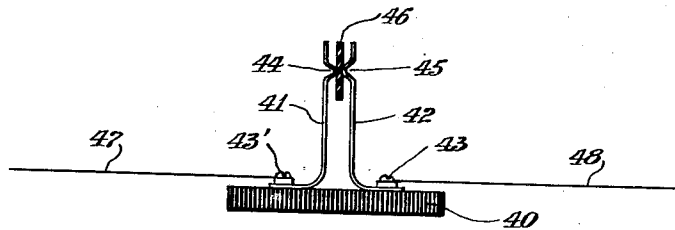


Fig. 4.

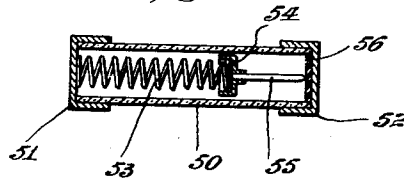
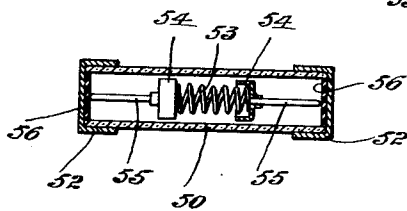


Fig. 5.



INVENTOR
Philip J. Kayatt
BY *[Signature]*
ATTORNEY

UNITED STATES PATENT OFFICE

2,179,935

HIGH POTENTIAL CUT-OUT

Philip J. Kayatt, New York, N. Y.

Application May 28, 1937, Serial No. 145,199

1 Claim. (Cl. 200—118)

This invention deals with protective devices which operate to prevent an open circuit occurring on series wire distribution circuits. Such circuits are of many types, such as street lighting circuits, neon tube signs and the like.

Series wired circuits are usually characterized by the employment of a power source of comparatively high voltage, since this voltage is divided between the individual power consuming devices wired in series along such circuit, consequently giving each such device only a fraction of the total voltage of the power source.

Normally, therefore, the potential existing across a single power consuming unit is very low compared with that of the power source, provided that a normal current flow is passing through all the units of the circuit, so that across each unit there appears the normal voltage drop. Under certain circumstances, however, such as for instance, when an individual letter of a series wired neon sign is broken or becomes of an extremely high resistance, the normal current flow through the remaining units of the circuits is thereby reduced. This brings about an abnormal rise of voltage across the particular unit which has thus become defective and in case that this defect amounts to an open circuit, practically the entire voltage of the power source is then impressed across the terminals of the defective unit.

My invention takes advantage of the abnormally high voltage thus produced across a defective unit and causes this voltage automatically to bring about a short circuiting closure of the terminals of the defective unit. This allows a substantially normal current flow to be reestablished through the power consuming devices constituting the balance of the series circuit, such as the other letters of a neon sign, where one letter has failed.

This partial restoration of service is frequently of very great value, especially in the case of signs containing a great number of letters, where the absence of a single letter will not seriously affect the legibility of the sign or in the case of street lighting circuits where it is extremely desirable that the failure of a single unit shall not plunge a large area served by such circuit into darkness.

It has been proposed to secure a short circuiting action in the case of the contingencies above outlined by allowing a spark to traverse a short gap connected in parallel with the terminals of a single unit, or by allowing a piece of paper or fibre to be punctured by the spark and thus rendered at least partly conducting by its carboni-

zation. Likewise it has been proposed to bring about the eventual closure of such spark gaps by movement of the gap electrodes into contact with one another, as by the gradual crumbling away of the paper or fibre as it carbonizes, or by the melting of fusible metal used to maintain an air gap between the electrodes.

These methods of circuit protection are open to many objections. A steadily operating spark gap is not only destructive, wasteful and generates such heat as to be a source of potential danger, but also such a gap is a source of undesired electrical disturbances which may be radiated for long distances over the distribution circuit lines and which constitute a source of interference to sensitive electrical apparatus, such as radio receivers. When paper or fibre is employed, its carbonization is usually very imperfect and a certain amount of sparking still occurs from one carbonized particle to another. Thus the objections of a spark gap are by no means completely removed when a paper or fibrous material is employed. Furthermore the high resistance of the carbonized material gives rise to the production of undesired heating effects which are not only wasteful but which may be dangerous to property.

My invention overcomes the above outlined objections by employing a spark gap which will automatically change to a low resistance metallic contact, by the closing together of the electrodes comprising the gap, when a breakdown of the unit to be protected has once occurred. Instead of solid materials such as paper or fibre, I employ an insulating material which will readily pass from a solid to a liquid state under the influence of an elevation of temperature. This insulating material likewise will fuse much more rapidly, due to its poor heat-conductivity, than will gap-closing devices using fusible metal which must be melted by the spark.

Thus, while solid materials are only slowly destroyed or carbonized by the electric arc or spark, the material which I employ will be rapidly reduced to a liquid form by the occurrence of such a spark. Additionally, such melted material will allow the ready movement therethrough of an electrical conductor. Accordingly I provide means for placing the electrodes of my spark gap under tension with respect to one another, and when a spark has occurred and melted the insulating material such tensioning means will operate to cause the two electrodes of my device to come in contact with one another.

In this fashion I secure practically perfect

metallic contact, which is free from the defects of continuing spark gaps or imperfectly conducting materials, as employed by the prior art.

One object of my invention is to provide means which shall form a substantially perfect cut-out of low resistance around an open circuited unit of a series wired circuit.

Another object of my invention is to provide such cut-out means as shall be free from high resistance and imperfect contacts and which shall not present the hazards of continuing sparks or of abnormal heating.

A still further object of this invention is to provide an automatic cut-out device of the short circuiting type which shall reduce any power waste thereat practically to zero, within an extremely short interval after it has commenced to function.

Yet another object of my invention is to provide automatic cut-out means of the high voltage type which shall not give rise to electrical oscillations or to disturbances with radio apparatus.

Another purpose of this invention is to provide an automatic cut-out which can be cheaply and easily constructed and which shall be small in size, so that it may be housed, if so desired, within a portion of the unit which it serves to protect.

Other purposes of my invention will be apparent from the drawing hereunto attached where Fig. 1 represents one embodiment of my invention.

Fig. 2 represents schematically, a portion of a series wired circuit, illustrating one possible method of wiring my invention into series circuits.

Fig. 3 shows another form of my invention.

Fig. 4 shows yet another form of my invention.

Fig. 5 shows a double-ended or symmetrical form in which my invention may be constructed.

Referring now to Fig. 1, an insulating base 11 is provided, upon which are mounted a series of metal uprights 12, 13 and 14, by any suitable means such as the angle irons 15. The upright 12 has connected thereto a wire 16 and the upright 14 has connected thereto another wire 17, these two wires respectively, constituting the electrical terminals of the device.

The middle upright 13 is provided with a suitable aperture 18, constituting a bearing through which moves a rod-like member 19, preferably provided at one extremity with a somewhat pointed end 20. Against the other extremity of rod 19 there pushes a compression spring 21, which is restrained at its other end by upright 14. This spring may be fastened to rod 19 and upright 14 by any suitable means such as welding thereto. Upright 12 carries upon one of its surfaces 22 a disc 23 of insulating material. For purposes of clarity I have shown this disc as having a substantial thickness, but it is to be understood that the thickness of this disc is dependent both upon the relative and the absolute values of the normal and the breakdown voltages which may be impressed thereacross in any particular instance.

Referring now additionally to Fig. 2, there are shown two tubes 30 and 31 which may represent individual letters of a neon sign or individual incandescent lamps of a series street lighting circuit. The current which supplies these units enters unit 30 by the conductor 32, passes through this unit and is transferred to unit 31 by conductor 33, leaving unit 31 by conductor 34. This current flow is as it normally occurs when both units are properly functioning.

In parallel with each of these units is connected

a protective device of the type shown in Fig. 1. Due to the insulating block 23, no current will normally be able to flow through the conductors 16, 17 which connect the protective device to the lamp unit.

However, when a lamp unit becomes of abnormally high resistance as by the breaking of such a unit, practically the entire voltage of the power supply will be impressed across conductors 16 and 17, as previously explained. The thickness and material of insulating block 23 is so chosen that the abnormally high voltage produced under these circumstances will be sufficient to puncture this insulating material, thus setting up an electric arc or spark between point 20 and upright 12.

I have found that a suitable material for construction of the insulating disc is sealing wax. This material presents practically infinite resistance to an electrical potential until this potential reaches such strength as to actually break down the sealing wax and puncture the same. As soon as the sealing wax is punctured by an electrical discharge which continues to flow through the line of puncture in the shape of an arc or spark, the heat generated by this discharge will very rapidly reduce the sealing wax to a liquid or semiliquid state. As the sealing wax liquefies, the rod 19 will be impelled by spring 21 and point 20 will travel through the softened or melted sealing wax until it comes into metallic contact with upright 12.

It can readily be seen that as long as point 20 and upright 12 are not in metallic contact with one another, there will be produced therebetween an electrical discharge which will continue to melt the sealing wax. Therefore it can be seen that this device cannot continue to operate as a spark gap, but will automatically bring about the complete closure of the spark gap which first occurs, when an abnormally high voltage starts it into operation.

By reference to Fig. 2 it will be noted that the protective unit connected across tube 30 can operate upon the failure of this tube, so as to bring about a complete metallic connection between the input and output conductors of this tube. In this fashion a failure of tube 30 will cause this electrical circuit to be completely cut out of the electrical circuit without in any way affecting the continued operation of tube 31.

While I have described sealing wax as a suitable material for use with my invention, yet many other suitable materials of similar type will be apparent to those skilled in the art. The choice of a particular material for this purpose will be determined by the dielectric strength desired, the melting point of the material, and other mechanical and electrical qualities dictated by any particular set of circumstances. In many cases I have found that the metal upright 12 may be coated with a suitable insulating material in the form of a thin film thereupon, thus dispensing with the presence of a discrete insulating disc such as 23.

While I have shown a suitable embodiment of my invention, it can readily be seen that such mechanism as there shown for moving the electrodes into contact with one another may be greatly varied in detail and may in many cases be greatly simplified.

Fig. 3 shows one very simple form which my invention may take. An insulating block 40 has fastened thereto two pieces of metal 41 and 42, 75

each bent at one point along its length approximately at a right angle.

These strips may be fastened by screws 43 and 43' to block 40 and are chosen of such elastic material that the upper portions thereof will tend to spring into contact with one another, unless kept separated. These members 41 and 42 may be provided with inwardly projecting depressions 44 and 45 at points opposite one another. A disc of insulating material 46 lies between these two depressions 44 and 45 and serves to keep members 41 and 42 from making electrical contact with one another.

Conductors 47 and 48 serve to connect this device into circuit in a fashion similar to that shown in Fig. 2. The operation of the form of Fig. 3 is similar to that of Fig. 1, except that the electrodes 41 and 42 are both capable of moving their respective upper portions toward one another when a high voltage discharge punctures and melts insulating disc 46.

In Fig. 4 I have shown my invention embodied in the form of a fuse-like structure, which form is suitable for use where space may be at a premium, especially if the device is to be incorporated within a portion of the structure to be protected, for instance within the housing which receives the end of a neon tube.

A body 50, of suitable insulating material, such as glass or fibre, is provided with metallic caps 51 and 52, fastened by any convenient means, such as cementing or threading, upon each end of the body.

A compression spring 53 presses at one end against cap 51, and at the other end is provided with a metal cap 54, carrying a metal rod 55, which is urged by the spring against cap 52. Between the rod and cap 52 is interposed a disc 56 of a material similar in type to that described above, i. e. a material which will soften or melt upon a temperature rise, such as that produced by a spark jumping therethrough upon the occurrence of an abnormally high voltage difference between the rod and the cap 52, thus allowing the rod to be forced into metallic contact with this cap. The current path under these conditions will be from cap 51, through spring 53, cap 54, rod 55 and cap 52. Caps 51 and 52 thus constitute the terminals of this form of my device and these terminals conveniently may be of such dimension as to be clipped within a fuse holder of conventional type, thus allowing ready interchange of protective units.

My device may additionally be put into operation by the occurrence of an abnormal temperature in the neighborhood of the insulating discs thereof, even though such high temperature be not produced by an electric arc or spark. In this fashion my device may be made to operate as a protective device in cases where some abnormal functioning of the circuit, such as sparking to a ground connection may have occurred, even if this circuit failure does not cause the development of a high potential across the protective device itself.

The form of my invention shown in Fig. 5 is similar to that of Fig. 4, except that the insulating disc is duplicated, so that the central electrode structure now carries a cap 54 and rod 55 at each end thereof and insulating discs 56, 56 appear at both ends of the casing. In this fashion the central structure is electrically inert under normal conditions of operation, thus reducing possible undesired leakage or corona discharges along the inner walls of the shell 50.

When a breakdown occurs with this form of my invention, a spark puncture will occur at both ends of the device and both rods 55, 55 will be pushed through their respective adjacent insulating discs 56, 56, as the latter melt under the heat of the spark discharge therethrough.

It is especially to be noted that just as soon as the insulating material of any of the embodiments of my invention here shown, has been punctured by the spark passing therethrough, the gap then will be through air, or other gases produced, by the spark, from the insulating material and/or the metallic electrodes. Such spark gap will be very short compared with the long air gap of devices which have no solid insulating material between their electrodes.

This arises from the fact that a comparatively thin layer of solid insulation is equivalent in resistance to electrical puncture, to a much longer air gap. Consequently when my solid insulation breaks down, the resultant spark will be very short and hot or as is termed "fat", compared with the long and "stringy" sparks of devices using air gaps necessarily comparatively long, usually of a length of the order of a centimetre, or a substantial fraction thereof, with commercial gas tube sign letters.

Additionally, the short, fat spark of my device is thermally shielded by the remainder of the insulation, in comparison with the ready loss of heat from a long spark through the air. Lastly this short, hot, and protected spark need only melt a material which will not readily conduct away the heat generated and which will fuse at a temperature very low in comparison with a metal fuse.

Due to the particular mode of operation just described, my device will yield a complete metallic short-circuit or shunt in a fraction of the time needed by the air-gap devices already proposed, and with the production of only a fraction of the electrical disturbances caused by the long and persisting sparks of these devices.

It will be noted that in all the species of my invention, the shortest path between the electrodes is through the fusible insulating material, which is in direct contact with both electrodes, so that the spark occurring between the electrodes upon electrical breakdown of the insulating material will not be compelled to pass through any air gap except the extremely short gap formed within the mass of the insulating material itself, by such breakdown.

The forms of my invention shown in Figs. 4 and 5, ensure that the spark can take only this particular path, by completely covering the surface of at least one electrode with insulating material. Thus the metal end caps 52—52 have their flat end surfaces protected from electrodes 55—55 by the insulating wafers 56—56, which completely cover such surfaces. Additionally, the body 50 of insulating material shields the cylindrical portions of these metal caps 52—52 from the electrodes 55—55. Therefore it becomes practically impossible for a spark to pass between the two electrodes of opposite potential, except through the desired path, i. e. through wafers 56—56, thus affording a more definite breakdown potential to exist, due to the path of such breakdown being a definite one, of definite length, and through a predetermined material, in comparison with the uncertain and erratic breakdown potentials needed for air gaps between surfaces which are not either sharp needle-points, or else

highly polished spheres, the erratic behavior of such air gaps being well known in the art.

I claim:

5 A cut-out of the shunting type including two fixed electrodes having at least a portion of their surfaces which face one another covered with a readily fusible solid insulating material, a third movable electrode normally insulated from both

said fixed electrodes and making contact with said insulating material upon both said fixed electrodes, and means tending to move said movable electrode into contact with both said fixed electrodes upon the fusing of said insulating material. 5

PHILIP J. KAYATT.