Nov. 9, 1937. E. A. LINDSLEY 2,098,647

ELECTROCUTING TRAP

Filed June 11, 1936

Fig. 1

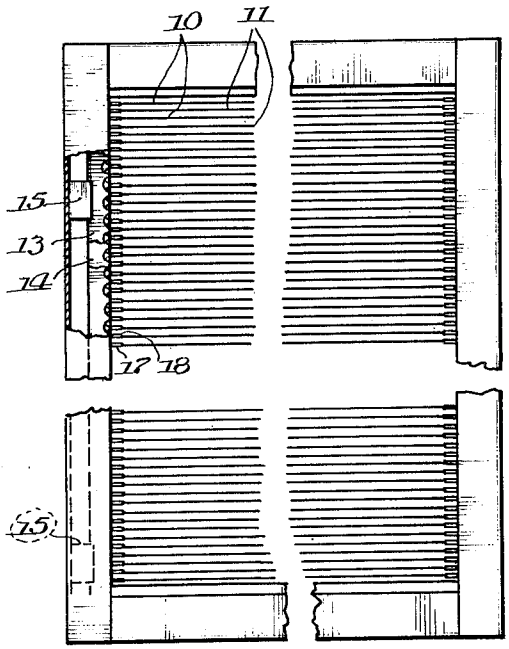


Fig. 2

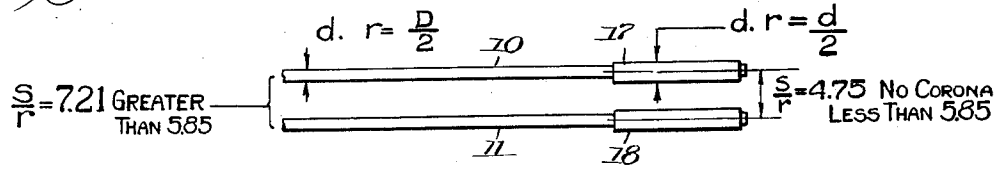


Fig. 3

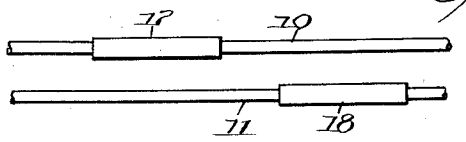


Fig. 4.

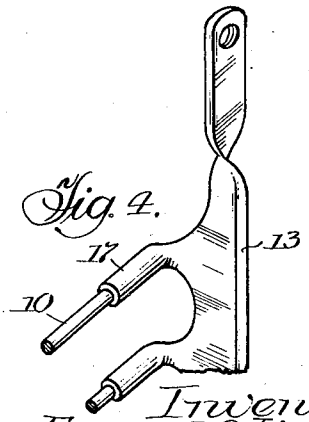
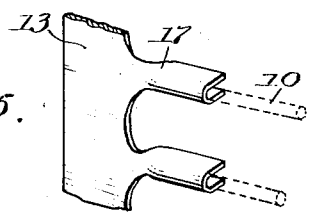


Fig. 5.



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UNITED STATES PATENT OFFICE

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ELECTROCUTING TRAP

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Application June 11, 1936, Serial No. 84,621

8 Claims. (Cl. 43—112)

The invention relates to electrocuting traps and primarily to those designed to electrocute insects, and involve spaced positive and negative electrocuting elements which, when current is applied thereto produces a corona effect between said electrodes capable of causing electrocution of an insect coming within the corona field. The invention has as one of its principal objects the use of spaced electrodes the ratio of the effective diameters of said electrodes to the effective spacing of said electrodes providing means whereby a corona discharge may be formed at said electrodes.

Another object of the invention is to employ electrodes having portions of relatively different effective diameters, the ratio of said effective diameters to the effective spacing of said electrodes providing means whereby a corona discharge may be formed on one portion of said electrodes and be prevented from forming at another portion at a given voltage.

The invention has as a further object the provision of means whereby corona formed on said wires or electrodes may increase their electrical diameter to compensate for the mechanical increase in diameter at the connections between supports for said electrodes so as to produce a uniform electrical breakdown between all portions of the electrodes or so that the air gap remaining to be broken down may be less at the wires than it is at said supports.

The invention also has as an object the provision of a construction involving bars providing spaced electrodes, the ratio of the effective diameters thereof to the effective spacing of said electrodes providing means whereby corona discharge may be formed at said electrodes, the connection formed between supports and the bars, being in the form of an enlargement or sleeve, the sleeve or enlargement of an electrode being spaced from the support or sleeve of an adjacent electrode and being of a diameter different than the smaller diameter of the electrodes, the ratio of the diameters of said sleeves to the spacing between said sleeves being such that corona does not form on said sleeve.

The invention also has as an object employing electrocuting elements or wires of a specific diameter, spaced a specific distance from each other so that corona may form at said electrodes at a given voltage and the use of sleeves or supports of another specific diameter greater than the specific diameter of said electrodes, but less than the diameter of said electrodes plus twice the height of the corona formed on said electrodes so that the air gap remaining to be broken down is less at the wire portion of the electrodes than it is at the enlarged portion of the electrodes.

The invention has these and other objects all of which will be explained in detail and more readily understood when read in conjunction with the accompanying drawing which illustrates one embodiment whereby the invention may be accomplished, it being obvious that mechanical changes may be resorted to without departing from the spirit of the invention as defined in the appended claims, forming a part hereof.

In the drawing:—

Fig. 1 is a front elevation of an electrocuting device illustrating a construction which may be resorted to, to accomplish the invention.

Fig. 2 is an elevation of positive and negative electrocuting elements of a certain diameter the centers of which are spaced a specific distance from each other to accomplish a corona condition and a breakdown of the corona at a particular voltage having a connection between a support for the electrodes and the electrodes, the ratio of the diameter of the connection to the space between adjacent connections being such that corona is prevented from forming between the connections, and in which the electrical breakdown strength is more at said connections than between the electrocuting elements.

Fig. 3 is a view showing a modified relation of the enlarged portions of the electrodes to the smaller portions and to each other.

Fig. 4 is a perspective view of a support and electrodes connected therewith.

Fig. 5 is a perspective of a modified construction of support and electrodes.

The structure herein shown and described for accomplishing electrocution of insects involves the use of positive and negative sets of electrocuting elements or bars of opposite polarity of certain diameters and spaced prescribed distances from each other to thereby provide a structure capable of sustaining a certain voltage and producing an electrical field between the electrocuting elements without breakdown of the field until caused to do so by entrance of an insect into the field. As will be seen, the device is designed for operation at a voltage just under, or as near as possible to, the breakdown strength or point of the field between the electrodes, and therefore when insects varying in size from a small gnat, to a fly or moth, enters this field, his body weakens the breakdown strength thereof sufficiently to cause electrical breakdown between the electrocuting elements causing electrocution of the insect. In order to accomplish operation and functioning of the device, as above indicated, it becomes necessary to apply as much voltage to the electrocuting elements as the strength of the air between adjacent electrodes will sustain without breakdown; or, in other words, it is desirable to apply as much voltage to the electrocuting elements as the strength of the intervening air will stand without breaking down, so that even

the smallest insect, when passing between the electrocuting elements, will weaken the field sufficiently to cause breakdown, thus electrocuting the insect.

To maintain the electrocuting elements in definite spaced relation to each other, supports are provided. The supports involve the use of sleeves which surround the individual bars at intervals of the length of said electrocuting bars or elements and thus become a part of said electrocuting elements. These sleeves increase the diameter of the electrocuting elements and since the centers of said sleeves and the centers of the remaining portion of the electrocuting bars or elements are in axial alignment with each other, said sleeves correspondingly decrease the spacing or breakdown distance of the space between the electrodes at the enlargements or sleeves which normally results in reduction in the breakdown strength of the air between the electrodes, due to these last-mentioned portions or enlargements of the electrodes. It was found, however, after trying various sizes of wires, sleeves and spacings, that there was one particular combination or ratio of wire and sleeve size and spacing where sparkover occurred between the wires instead of at the sleeves, and that by employing a ratio of wire and sleeve sizes and spacings, as hereinafter described, the breakdown strength of the space intervening throughout the length of said electrodes is maintained. In other words, by maintaining a certain definite ratio between wire sizes, sleeve sizes and spacing, it is possible to support the wires by sleeves or enlargements which increase the diameter of the electrocuting elements and decrease the space between the enlargements without decreasing the breakdown strength between the enlargements. The breakdown distance between the sleeves being less than the breakdown distance between the remaining portion of the electrodes, would lead to the belief that breakdown of the device would occur at the enlargements rather than at the remaining portions of the electrodes, upon application of a voltage sufficient to cause this action. However, in the structure shown, breakdown occurs between the portions of smaller dimension and greater space, and not at the portions of larger dimension and smaller spacing, or that portion involving the sleeves. Upon experiment, the particular ratio of wire sizes and spacing herein referred to disclosed that as the voltage applied approached the breakdown point, corona appeared upon the smaller dimension of the electrodes, however was not present upon the enlarged portions or sleeves, indicating an approaching breakdown of the structure at the portions of smaller dimension and greater spacing, and not at the portion of larger dimension and smaller spacing between electrodes. It is an accepted fact that the breakdown voltage between electrodes in air varies greatly with the size and shape of the electrodes, and since smaller and more pointed electrodes have a lower breakdown than larger and more blunt electrodes, at the same spacing, and that corona is an ionization of the air surrounding a conductor and causes the air to become a conductor instead of an insulator, this results in the effect of increasing the size of the wire or electrode at its smaller dimension sufficiently to compensate for the mechanical increase of the size of the sleeves or enlargements. In other words, by employing sleeves or enlargements of a certain diameter upon each electrode, the normal breakdown strength of the field between the electrodes at this point is maintained, thus enabling the device to be operated at a voltage approaching the breakdown strength between the smaller dimensions of the electrodes, provided the enlargements are of a dimension and spacing that corona cannot form at the sleeves. In other words, since smaller or more pointed electrodes have a lower breakdown strength than larger and more blunt electrodes, and the electrodes herein employed have both a large and a smaller dimension portion, the breakdown strength at the sleeves or enlargements is greater than the breakdown strength of the smaller dimension, which thus enables the device to be operated at a voltage approaching the breakdown between the smaller dimensions of the electrodes without sparkover at the enlargements and other portions thereof until introduction of an insect to the field between electrodes. The structure disclosed results in several advantages, among which is the advantage of permitting the use of relatively small diameter electrodes, which reduces the necessary material and cost of manufacture of devices of this character, and, in addition, allows these relatively small diameter electrodes to be properly supported and spaced a distance from each other sufficient to produce a killing effect upon insects of various sizes, from a small gnat to a relatively large insect, such as a moth.

It is generally conceded in the electrical art that at a given voltage a sparkover in air between several electrodes will always occur between those electrodes having the shortest distance between them and that as the distance between electrodes is increased the liability of sparkover at a given voltage is correspondingly reduced. In the particular arrangement of electrodes herein shown the sparkover does not usually occur at that portion of shortest distance but usually occurs at a place of greater separation at a given voltage. To accomplish this last mentioned mode of operation, I found that with a certain particular combination of wire and sleeve sizes and spacings, that it is possible to prevent sparkover at the point of lesser distance or that point usually considered as the point of greatest weakness and that the point of actual weakness occurred at the point of greater dimension.

The particular electrocuting screen employed herein to illustrate a structure whereby the invention may be accomplished utilizes, sets of bars or electrocuting elements 10 and 11 of opposite polarity arranged alternately with respect to each other which are located in substantially the same plane. The respective sets of electrocuting elements are connected to supports respectively designated 13 and 14 which are provided with means to maintain the electrocuting elements at a prescribed, definite distance from each other. In the particular construction shown the supports are mounted in a frame and separated from the frame and each other through the agency of suitable insulators 15—15.

The supports 13 and 14 are each provided with a plurality of means respectively designated 17 and 18 which in the present instance are in the form of enlargements or sleeves which embrace the electrocuting elements of each set and are of a relatively greater diameter than the remainder of the electrocuting elements or bars 10 and 11, and, have centers which are spaced a distance corresponding to the distance between the centers of the smaller portions of the electrocuting bars 10 and 11. This relative difference of diameter between the sleeves 17 and 18 and the

bars 10 and 11 and the fact that these elements have their centers spaced a certain corresponding distance from each other causes corona to form on the electrocuting bars 10 and 11 without causing a like electrical effect at the sleeves or enlargements respectively designated 17 and 18, upon the application of a prescribed voltage to said electrocuting elements and sleeves.

In other words, each electrocuting element is formed to provide portions of relatively different diameters, the ratio of the effective diameters to the effective spacing of the electrodes providing means whereby corona discharge may form on one portion such as the smaller diameter of said electrodes and be prevented from forming on another portion such as the sleeves at a given voltage. The corona formed on the smaller portion of the electrodes increases their electrical diameter, the increase of diameter at the larger portion of the electrodes being limited to the mechanical diameter of the enlarged portion thereof, so that the increase of electrical diameter may compensate for the mechanical increase at the enlarged portions.

It has been found that a certain ratio between the spacing and wire diameters, or minimum critical spacing ratio above which corona must form before and below which corona cannot form before flash-over takes place between the electrodes at a given voltage. The ratio between the spacing and wire diameter of the smaller portions of the electrodes in the present structure is over the minimum critical spacing ratio, however, the enlarged portion of the electrodes is under the minimum critical spacing ratio. Therefore, the device may be operated just below the breakdown point, which permits the corona to increase the electrical diameter of the smaller portion of the electrode and compensate for the mechanical increase in diameter of the larger portion thereof.

It has been found that the minimum critical spacing of the electrodes which may be resorted to, below which a spark will strike across before corona can form, for parallel wires is $S/r=5.85$ where r is the radius of the wires and S is the spacing between their centers. The electrodes herein shown have portions of different diameters, the smaller diameter portion being .104" with a radius of .052" while the diameter of the sleeves is .158" with a radius of .079". The center to center spacing of the electrodes herein employed is about 3/8" or .375". Thus at this spacing of the said electrodes the ratio between the smaller portion is greater than the minimum critical spacing ratio, and the enlarged portion is less than the minimum critical spacing ratio at which corona will form. The sleeves 17 and 18 are approximately .027" thick each, which results in spacing, between the electrocuting elements at this point .271"−.054"=.217".

In the structure herein shown at the smaller portion of the electrodes S=.375" and r=.052"

$$\frac{S}{r}=\frac{.375}{.052}=7.21$$

which is greater than 5.85 the critical minimum spacing ratio, however, at the sleeve portion or enlargement of the electrodes S=.375" and r=.079",

$$\frac{S}{r}=\frac{.375}{.079}=4.75$$

which is less than the minimum critical spacing ratio. The flash over voltage between applicant's wires spaced approximately .271 inch apart is slightly over 5000 volts. Therefore, since the ratio between the spacing and wire diameter is over the "minimum critical spacing ratio" corona will form on the smaller portion of the electrodes, but not on the enlarged portions. From the foregoing description of the invention it is manifest that the ratio of the effective diameters of the electrodes to the effective spacing of said electrodes provides means whereby corona discharge may be formed at said electrodes, at a given voltage and also that said electrodes are formed to provide portions of different effective diameters, the ratio thereof to the effective spacing of said electrodes providing means whereby a corona discharge may be formed at one portion of said electrodes and be prevented from forming at another portion at a given voltage.

It is also evident that the structure described provides means whereby corona formed on said wires or electrodes, increases their electrical diameter to compensate for the mechanical increase of diameter at the connections or enlargements such as 17 and 18, which thereby produces a more uniform breakdown condition between the electrodes or to eliminate an apparent weak point between the sleeves.

It is further evident that in the structure described the ratio of the effective diameters to the effective spacing of said electrodes provides means whereby corona discharge may be formed at said electrodes at a given voltage. Having described the invention what I claim and desire to cover by Letters Patent is:—

1. An electrocuting trap having electrodes, each electrode being formed with portions which respectively provide means for producing and preventing a corona discharge.

2. An electrocuting trap having electrodes, one of which is formed with portions which respectively provide means for producing and preventing a corona discharge.

3. An electrocuting trap including spaced electrodes having portions of relatively different effective diameters, the ratio of said effective diameters to the effective spacing of said electrodes providing means whereby a corona discharge may be formed on one portion of said electrodes and be prevented from forming at another portion at a given voltage.

4. An electrocuting trap including spaced electrodes having portions of relatively different diameters, the ratio of said diameters to the spacing of said electrodes providing means whereby a corona discharge may be formed on one portion of said electrodes and be prevented from forming at another portion at a given voltage.

5. An electrocuting trap including straight bars providing spaced electrodes, said electrodes being spaced with respect to their diameters so that corona may form between said electrodes, sleeves respectively providing supports for said bars, the sleeve of one electrode being spaced from the sleeve of an adjacent electrode and being of a different diameter than said electrodes, the ratio of the diameters of said sleeves to the spacing between said sleeves being such that corona cannot form on said sleeves.

6. An electrocuting trap including straight bars providing spaced electrodes, said electrodes being spaced with respect to their diameters so that corona may form between said electrodes, enlargements respectively providing supports for said bars, the enlargement of one electrode being

spaced from the enlargement of an adjacent electrode and being of a different diameter than said electrodes, the ratio of the diameters of said enlargements to the spacing between said enlargements being such that corona cannot form on said enlargements.

7. An electrocuting trap having electrodes of opposite polarity spaced from each other, the ratio of the effective spacing of corresponding portions of said electrodes to the effective diameters of said portions of the electrodes causing formation of corona to be limited to a certain portion of said electrodes at a given voltage.

8. An electrocuting trap having electrodes of opposite polarity spaced from each other, having portions of relatively different effective diameters, the ratio of said effective diameters to the effective spacing of said electrodes being such that corona discharge is prevented from forming on said portion of larger diameter at a given voltage.

EDWARD A. LINDSLEY.